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REVIEW

THE ETHNOBOTANY OF FERNS AND LYCOPHYTES

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ABSTRACT

A summary is presented of the most important ways in which ferns have been important to humanity. Many of these categories are positive such as the use of ferns for subsistence. On the negative side is their role as weeds and as bearers of substances harmful to human health. Many of the traditional uses such as for medicines have been transferred to modern life as societies have modernized. Some uses have even become important in industrial society, for example in the assay of new medicines.

INTRODUCTION

Ferns are distributed in all climate zones of the planet, but have a greater diversity in the tropics (Smith *et al.*, 2006; Strasburger *et al.*, 2003). The discipline that studies the relationship between the uses of ferns and humans has been termed ethnopteridology, and it was well explained and amplified by Boom (1985). These reciprocal interactions may or may not be related to a particular use category in family or regional cultures, but the concept of ethnobotany goes beyond the utilitarian spheres of economics and uses to include symbolic values, nomenclature, religion and also the place that particular plants occupy in the cosmology of peoples. Strictly economic aspects of uses are addressed by the discipline of economic botany. It is not easy to separate economic botany and ethnobotany and indeed economic botany implies a type of relationship between human groups and plants.

The object of this work is to present a global panorama of the state of the art in ethnobotany of pteridophytes. We will show the great diversity of relationships between these plants and humans. Pteridophytes feature in some way in many papers about ethnobotany and economic botany and here we will concentrate mainly on papers whose object was specifically about the study of ferns or lycophytes. A few previous papers have addressed similar topics at least locally. For example, May (1978) made a summary of the economic and folkloric uses of ferns. Díaz de León *et al.* (2007) reviewed the many uses of ferns and lycophytes in Mexico and to some extent the rest of the world. Murillo (1983) produced a major work on the uses of ferns in South America with a special emphasis on the ferns of Colombia. Mannar Mannan *et al.* (2008) gave a short review of the potential uses of ferns. We have used the names as cited in the various papers rather than trying to update the nomenclature in any way. The literature about the reciprocal relationships between humans and pteridophytes is so extensive that here we cannot possibly cover it all, but we hope to show the variety of possible relationships through presenting a number of wide-ranging examples.

ARCHAEOBOTANY

Archaeobotany is the study of ancient plant remains found in archaeological contexts. The name is obviously a parallel to, and a derivative from, ethnobotany. In both archaeobotany and ethnobotany the focus of attention is upon the uses of plants by, and their association with people (Wiley, 1995). Since remote times human populations in many parts of the world knew and made use of ferns and lycophytes. The archaeological literature offers much evidence of the close relationship between humans and these plants over many generations. Anderson & White (2001) suggested that *Cyathea* was used for consumption by humans at least 888 years ago in Norfolk Island. Dental evidence from human remains in New Zealand show ancient use of the rhizomes of *Pteridium esculentum* (G.Forst.) Cockayne (Houghton, 1978). In China there was use of edible ferns at least 3000 years ago (Zhang, 2007). There is evidence of the prehistoric use of the leaves of *Marattia fraxinea* Sm. in ritual involving the incipient use of iron in Africa (Schmidt & Avery, 1983).

FERNS IN PRE-LINNEAN LITERATURE

Our study has shown that fern ethnobotany is nothing new and that there is much about ferns and local cultures in ancient literature. We have mainly concentrated here on the more recent literature, but a good example of early studies of fern ethnobotany is that of Georgius Everhardus Rumphius (1627-1702) in Ambon, now in Indonesia (Rumphius, 2011). Rumphius devoted 44 pages to descriptions of ferns, lycophytes and their uses. The pre-Linnean names are often hard to identify to species, but the good drawings and the interpretation by E. D. Merrill (1917) make it possible to relate to current species names. These pages are full of ethnobotanical information about fern uses by the Ambonese and natives of other islands in the seventeenth century. Many of these uses come under the subheadings we have used below. For example one chapter is entitled "The Edible Fern" and is about *Athyrium esculentum* (Retz.) Copel. Rumphius said that this fern and related species "are a renowned potherb of all of these islanders. One can make a good salad from its leaves and shoots....it cools moderately and loosens the bowels, especially if one drinks some tree-wine after it." Rumphius describes the culinary use of several different species of ferns together with great details about the effects of eating them. The Balinese stick the tops of *Tectaria crenata* Cav. behind their ears when they go to war, because this plant will keep them from getting hurt by dart poison, rendering it powerless. They also rub the dry leaves over their bodies when bathing to get rid of sweat and odours. The lower stems of *Lygodium circinnatum* (Burm. f.) Sw. are split into four strips and used for seams around the edges of baskets by the Ambonese. An interesting use of the leaves of *Drynaria sparsisora* (Desv.) Moore is to tie them to a baited fishhook and use them as sails to carry the hooks out to sea until fish bites. The leaves of the same species are suspended over little children to keep them safe from evil spirits. The pages of Rumphius contain much interesting fern ethnobotany and many similar uses are reported in the more recent literature on the subject.

ETHNOPTERIDOLOGY

In the literature surveyed we found a number of articles that were specifically about ethnopteridology of human groups and also ethnobotany about individual species of pteridophytes, and we highlight examples of recent works from different continents. From the Americas, Navarrete *et al.* (2006) presented information on the uses attributed to more than 200 species of pteridophytes of Ecuador, Peru and Bolivia. Boom (1985)

treated the use of ferns by the Chácobo tribe of Amazonian Bolivia and Macía (2004) compared the ethnopteridology of the Tacana of Bolivia with that of the Huaorani of Ecuador. The only species in common was *Cyathea pungens* (Willd.) Domin. Hernández Cibrián & Sutherland (2007) carried out an ethnobotanical study of the ferns of a national park in Honduras and found only eight species that were used by the local population. For Argentina Keller *et al.* (2011) treated the various uses of 50 species of ferns and lycophytes by the Guaranies of Misiones Province (Figures 1-3) and Hurrell & De La Sota (1996) did the same for the villagers of Santa Victoria in Salta Province. In Asia Christensen (1997) studied the ethnopteridology of ethnic groups in Malaysia. A study of the ethnobotanical uses of ferns in the Indian States of Jammu and Kashmir (Kirn & Kapahi, 2001) listed 17 species of which 11 were medicinal, four used for thatching roofs and three as foods. Joshi (1997) listed ethnobotanical uses of 44 species of ferns in Uttar Pradesh State of India.

For Africa the ethnopteridological study of ethnic groups by Nwosu (2002) mentioned 36 species in 23 families. In addition to fern uses for food and medicines, many of these studies mention uses in rituals of love, for magic ceremonies, as indicators of cardinal points and the presence of animals and also as material to make crafts and weapons. The demands of today's markets have led various indigenous groups to commercialize ornamental ferns and flowerpots made out of erect rhizomes and the trunks of tree ferns.

FERNS IN TRADITIONAL MEDICINE

Studies of uses of ferns in ethnomedicine are abundant on all inhabited continents. In Córdoba (Argentina) the study of ferns used in traditional medicine has developed to

Figure 1. *Microgramma squamulosa* (Kaulf.) de la Sota, a multipurpose species for the Guarani, used for slimming, menstrual analgesic, post partum washing, and treatment of lumbago.

such an extent that anatomical and morphological evidence is used to detect adulterants of the products (Luján *et al.*, 2007; 2011). However, the adulteration of medicinal ferns is nothing new. Hipólito Ruiz (1805) described the species *Polypodium calguala* Ruiz with the intention of clearly differentiating this medicinal ethnospecies of the indigenous peoples of Peru from other fern species that were being imported into Spain from the New World as adulterants of the legitimate "*calaguala*."

In a comparison between the ethnopteridology of the Tacana of Bolivia and the Huaoraní of Peru, Macía (2004) found that 76% of the recorded uses for ferns were medicinal either for people or for animals to heal wounds or expel parasites. Most of the uses by the Tacana are external, whereas the Huaorani uses are mainly internal. This study cites uses for 24 species of ferns and lycophytes. There are many medicinal uses of ferns in India. For example, Sharma and Vyas (1985) described the use of six species in Rajastan. Srivastava (2007) emphasised the importance of ferns in tribal medicine from a study made in various places throughout India. Benniamin (2011) reported on the use of 51 species of ferns in the east of India and Kumari *et al.* (2011) gave information about the use of 66 species in ethnomedicine in India. Dixit (1982) is an example of the ethnobotanical use of a single species, *Selaginella bryopteris* (L.) Bak. This species is much revered in local medicine and commands a high market price. The medicinal use of *Helminthostachys zeylanica* (L.) Hook. has had serious effects on its state of conservation in Himalaya (Joshi, 2011). *Osmunda regalis* L. is used as a medicine in the north of Spain (Molina *et al.*, 2009).

Of the 36 species of ferns reported in the ethnobotany study of ferns of Southern Nigeria by Nwosu (2002), 34 have medicinal uses. The paper reads like a complete

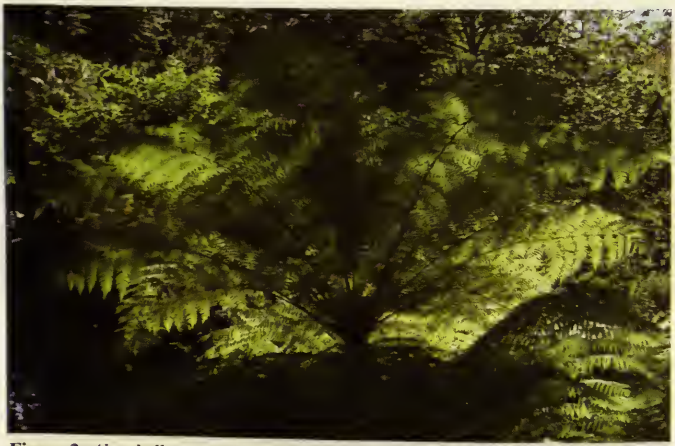

Figure 2. *Alsophylla setosa* Kaulf. The base of the rhizomes are used as stands for ornamental plants. The Guaranis and local farmers agree that the presence of this fern is an indicator that the soil is not suitable for agriculture. The Guarani use a soup of the petioles for the treatment of herpes.

pharmacy to treat many different ailments and all from pteridophytes. Ferns supply treatment for external injuries and wounds and many are taken internally to treat such diseases as malaria, ulcers, intestinal worms, liver disease etc. Many of the species listed have multiple uses, for example, a decoction of the rhizome and leaves of *Polypodium microrhizoma* Clarke ex Bak. is used for the relief of gastrointestinal disorders, backache and jaundice; a paste from the dried leaves (dried over an open fire) is applied externally for fissures on hands and wound healing; and a paste mixed with palm-kernel oil is applied externally to domestic animals such as sheep and cattle. The whole plant of *Osmunda regalis* is taken internally for psychosis as it is believed that the tonic can chase away evil spirits, and an infusion of the roots is used to treat malaria and jaundice.

The importance of medicinal ferns is evidenced by the growing interest in methods for their reproduction. An example is the achievement of *in vitro* propagation of the Asiatic fern *Drynaria quercifolia* (L.) J.Sm. that is much used in traditional phytotherapy (Mazumder *et al.*, 2011).

VETERINARY

The literature has many examples of the use of ferns for treating animals. According to Nwosu (1922), the leaves of *Tectaria macrodonta* (Fée) C.Chr. are powdered and mixed with castor oil and given to goats and sheep to stop a running stomach; young fronds are chewed by cows after delivery of a calf to accelerate the expulsion of the afterbirth.

EDIBLE FERNS

Fern rhizomes were an important source of food for Native Americans in western North

Figure 3. The rhizome of *Dicksonia sellowiana* Hook. in a Guarani basket offered for sale at a roadside stand.

America. Turner *et al.* (1992) produced a summary of this in a detailed paper that listed at least 15 species of ferns together with their native nomenclature. Ferns are much eaten in India. For example, Pandy and Pangtey (1987) list seven different species of ferns consumed in Western Himalaya and Joshi (1997) lists 10 edible species used in Uttar Pradesh State. For China, Liu *et al.* (2012) listed a total of 42 edible pteridophytes, but they estimated that the potential total could be as high as 144 species. Some ferns are eaten as though they were sweets, as in the case of *Pecluma pectinatiformis* (Lindm.) M.G.Price, where the sweet leaves are commonly chewed by Guaraní children in Misiones, Argentina (Keller *et al.*, 2011).

Some species of *Polypodium* are known for their property of sweetness. A variety of *Polypodium vulgare* L. was used to flavour tobacco for its liquorice taste and it contains small amounts of ostadin, a steroid saponin 3000 times as sweet as sucrose. In former times the fronds of this species were used in Ireland to treat coughs, colds and asthma. *Polypodium glycyrrhiza* D.Eaton also has a liquorice flavour and was eaten by Native American peoples (Mabberley, 2008).

FERNS AS BUILDING MATERIALS

The Guaranies of southeastern Brazil use the stems of *Dicksonia sellowiana* Hook. to support the walls of their traditional houses (Prudente, 2007).

Joshi (1997) lists *Cyathea spinulosa* Wall. ex Hook. and *Dicranopteris liniaris* (Burm. f.) Underw. as used for thatching roofs in India. Kirn and Kapahi (2001) mention *Pteridium aquilinum* (L.) Kuhn. var. *wightianum* (Ag.) Tryon, *Pteris vittata* L., *Thelypteris erubescens* (Wall. ex Hook.) Ching and *Woodwardia unigemmata* (Makino) Nakai for the same purpose.

FERNS IN ORNAMENTATION AND ART

Ferns are often used for body ornamentation. The stipes of *Cheilanthes farinosa* (L.) Brogn. and *Adiantum lunulatum* Burm. are used as nose and ear studs by children and poor women in Uttar Pradesh (Pande & Pangey, 1987) and *Adiantum venustum* D. Don is used as ear studs by girls in Kashmir (Kirn & Kapahi, 2001). The tree ferns *Cyathea divergens* var. *tuerckenheimii* R.M.Tryon and *C. fulva* (Martens & Galeotti) Fée are harvested to produce handicrafts for garden ornamentation by artisans of the mountains of Cuetzalan, Mexico (Elutério, 2006). In the Philippines the petiole and leaf rachis of *Lygodium japonicum* (Thunb.) Sw. are used to decorate baskets (Novellino, 2006). In Argentina the Guaranies use the petioles of various ferns to make necklaces (Keller *et al.*, 2011).

USES OF FERN SPORES

Frye (1934) reported that the spores of *Lycopodium clavatum* L. were used for dusting on open raw wounds and chafed infants by natives of northwestern North America. The spores are fine and light and so repel water and prevent stickiness. Lycopodium powder has also been used as a lubricating dust on latex gloves and condoms, though the latter use is not recommended (see Balick & Beitel, 1989), because these spores have been known to cause allergic reactions, ranging from hay-fever to more serious giant cell granulomas. May (1978) reported that the easily flammable spores of species of *Lycopodium* have been used in theatre as a flash powder.

FERNS AS PLACE NAMES

The importance of ferns to local communities has often led to the names of places, topographic formations, watercourses and political divisions. In Misiones Province (Argentina), the most tropical and wettest province of Argentina, there are various places based on plant names. The 'Diccionario geográfico toponímico' of Stefañuk (2009) gives several examples. "Los helechos" is the name of a stream and a municipality in this province. In the town of Oberá there is a place and a stream named "Samambaya" the common name for ferns derived from the Guaraní word for them "amambái" which translated into English is a generic name of ferns. Locally amambái refers to the large populations of *Pteridium arachnoideum* (Kaulf.) Maxon. In the Department of L.N. Alem there is a stream called "Chachi" which is the Guaraní name for the tree fern *Cyathea atrovirens* (Langsd. & Fisch.) Domin (Cyatheaceae). In the Department of San Martín there is stream called "Culandrillo", a term that refers to species of the genus *Adiantum* (Pteridaceae). In Paraguay the derivation of the name of the political division Amambay Department is derived from the Guaraní word for fern. There are many place names in the United Kingdom associated with ferns, for example, Ferndown in Dorset, Fernilee in Derbyshire and Ferness in the Highlands. Fern is a town in Tayside and Fernie a stream and a castle in Fife. Bracken (*Pteridium aquilinum*) features in Brackenfield in Derbyshire and Brackenthwaite in Cumbria.

FERNS IN PHARMACOLOGY

Substances with antioxidant activity are now used in medicine to reduce the effects of oxidation stress. Antioxidant activity has been reported in *Adiantum capillus-veneris* L., a widely distributed fern (Kumar, 2009). A recent study of the lateral branches of *Equisetum giganteum* L. of South and Central America showed that they can be used as a source of antioxidant compounds (Ricco *et al.*, 2011). In Malaysia studies have shown similar properties in various ferns: *Blechnum orientale* L., *Cibotium barometz* (L.) J.Sm., *Cyathea latebrosa* (Wall. ex Hook.) Copel., *Dicranopteris linearis* Burm., *Drynaria quercifolia* (L.) J.Sm. and *Stenochlaena palustris* (Burm. f.) Bedd. (Chai *et al.*, 2012; Lai & Lim, 2011, Lai *et. al.*, 2010). In China several fern rhizomes have been shown to have antioxidant properties: *Drynaria fortunei* (Kze.) J.Sm., *Pseudodrynaria coronans* (Wall. ex Mett.) Ching, *Davallia divaricata* Bl., *D. mariesii* Moore ex Bak., *D. solida* (Forst.) Sw., and *Humata griffithiana* (Hook.) C.Chr. (Chang *et al.*, 2007).

Ferns also contain substances with antibacterial activity as was shown in the study by Thomas (2011) of *Osmunda regalis.* India has made important advances in this area and Kumarpal (2013) showed that there was good antimicrobial activity in three species of ferns from three different families used in traditional medicines in Darjeeling, *Athyrium filix-femina* (L.) Roth (Woodsiaceae), *Dicranopteris linearis* (Burm. f.) Underw. (Gleicheniaceae) and *Pleopeltis macromarpa* (Bory ex Willd.) Kaulf. (Polypodiaceae). Patric Raja *et al.* (2012) found antibacterial and antifungal activity in *Cyathea nilgiriensis* Holttum, *C. crinita* (Hook.) Copel., *Leptochilus lanceolatus* Fée and in *Osmunda hugeliana* Presl. Studies made in Romania by Soare *et al.* (2012) showed that the bladder fern *Cystopteris fragilis* (L.) Bernh. and *Polypodium vulgare* L. strongly inhibited various bacteria, especially *Escherichia coli.* Most of the species that have been studied for their pharmaceutical properties have notable antecedents in traditional medicine. The development of pharmaceuticals from plants used in the pharmacopeia of local peoples ought to ensure that the benefits are shared with the traditional communities from where the original information came (Prance, 1991).

FERNS IN TOXICOLOGY

The relationship between plants and people is not always a positive one This includes those species that have strong substances that are damaging either to human health or to that of domesticated animals. *Pteridium aquilinum* has been studied for the relationship between the various uses and its toxicity (Alonso Amelot, 1999; Franca *et al.*, 2002; Ortega, 1993; Vetter, 2011). Recent studies show that *Blechnum orientale* is able to absorb heavy metals from the environment and it is therefore a potentially toxic source of food and medicine. The accumulation is mostly in the rhizomes and leaves, the very parts of the plant that are eaten (Zhu *et al.*, 2013). A positive side for the environment of this absorptive capacity of ferns is the accumulation of arsenic by *Pteris vittata* L., which could be used as a method of decontaminating toxic sites. Phytoremediation of arsenic contaminated environments will involve growing the arsenic hyperaccumulator ferns in the contaminated environment, harvesting the arsenic-rich biomass and the safe disposal of the biomass (Gumaelius, 2004; Rathinasabapathi *et al.*, 2006).

FERNS AS ORNAMENTAL PLANTS

A large number of fern species are used as ornamentals in the gardens around the world, and this dates back to ancient times and often to domestication for other uses. Studies of the ornamental potential of pteridophytes of regional floras has led to an increase of their use as cultivated plants. Abraham *et al.* (2012) listed a total of 153 ferns and 18 lycophytes from Nilgiris, India with ornamental potential. Macaya (2004) mentioned 20 species of ferns native to Chile that are cultivated as ornamentals and in Macaya (2008) he expanded this to a list of 75 species. An example of the relevance of ethnobotany for making strategies for use of populations of native vegetation is that of Baldauf *et al.* (2007), who made an ethnobotanical study of the management systems of *Rumohra adiantiformis* (G. Forst.) Ching. This species is used as an ornamental in southern Brazil. Another fern of the southern cone region of South America with high ornamental potential is *Blechnum tabulare* (Thunb.) Kuhn, a species that resembles the Cycadaceae in appearance. A population study of this species was made in southern Brazil (Rechenmacher *et al.*, 2007). The stems of some tree ferns are used extensively as a substrate for the cultivation of epiphytes. However, the indiscriminate use of this resource is threatening populations of these plants in some places. An example of this is the use of *Dicksonia sellowiana* Hook., the conservation of which has led to studies of growth, phenology and germination of spores (Filippini *et al.*, 1999; Schmitt *et al.*, 2009).

FERNS AND SOIL QUALITY

Azolla Lam. has long been used as a fertilizer in rice paddies (Jones, 1987). In Misiones, Argentina farmers identify compacted and degraded soils by means of observations on the presence of *Pteridium aquilinum*. In the central Andean region of Peru indigenous peoples of the Quechua language group use the fronds of *Dennstaedtia glauca* (Cav.) Looser to fertilize the soils where they cultivate potatoes (Camino & Jhons, 1988), which is similar to the use of bracken peat as a fertilizer in some places in the United Kingdom.

CONCLUSIONS

This brief summary has shown the diversity of important uses to which humans have put ferns and lycophytes, and some of these are illustrated in Figures 1-3. Many of these use categories originated in traditional societies (the white area of Figure 4) such as use in rituals, the construction of houses and to make weapons. Other uses are typical of

contemporary society (the dark area of Figure 4) such as the large scale commercialization of ornamental plants and for drug prospecting. However, the division between traditional and modern uses is not precise because many uses fall into both social categories (the grey area of Figure 4). For example many medicinal uses arose in traditional societies that have gradually modernized, still using ferns in their medicine but also leading to prospecting and use in pharmacology. This much more intensive use of ferns in modern societies has led to the destruction of the habitats where they grow. This has increased the importance of habitat conservation of ferns and the development of commercial production rather than harvesting from the wild.

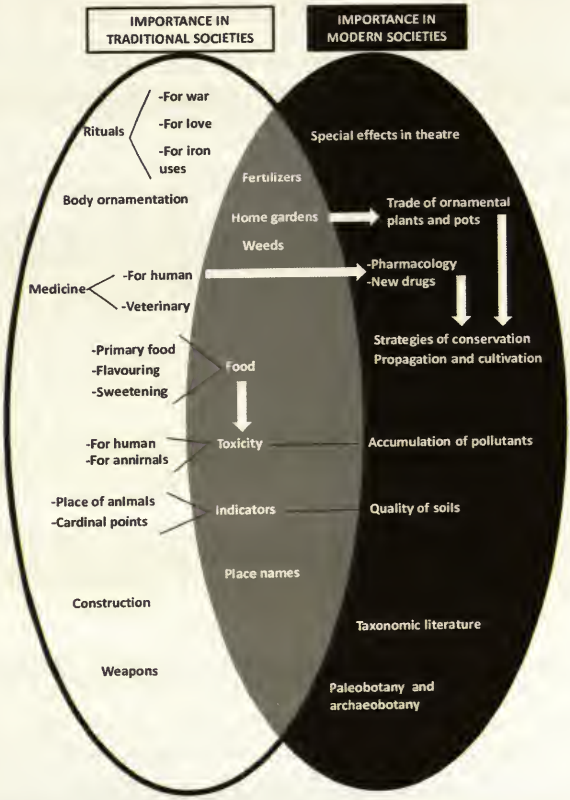

Figure 4. Examples of the importance of ferns in traditional and modern contexts.

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REFERENCES

ABRAHAM, S., RAMACHANDRAN, V.S. & SOFIA, C. 2012. Potential ornamental Ferns from Nilgiris, Tamil Nadu. Advances in Applied Science Research 3 (4):2388-239.

ALONSO AMELOT, M. E. 1999. Helecho macho, salud animal y salud humana. Rev.Fac. Agron. (LUZ) 16: 528-541.

ANDERSON, A. & WHITE, P. 2001. Approaching the Prehistory of Norfolk Island. Records of the Australian Museum, Supplement 27: 1–9.

BALDAUF, C., HANAZAKI, N. & SEDREZ DOS REIS, M. 2007. Caracterização etnobotânica dos sistemas de manejo de samambaia-preta (*Rumohra adiantiformis* (G. Forst) Ching - Dryopteridaceae) utilizados no sul do Brasil. Acta bot. bras. 21(4): 823-834.

BALICK, M. J. & BEITEL, J. M. 1989. *Lycopodium* spores used in condom manufacture: associated health hazards. Economic Botany 43: 373-377.

BENNIAMIN, A. 2011. Medicinal ferns of North Eastern India with special reference to Arunachal Pradesh. Indian Journal of Traditional Knowledge 10(3): 516-522.

BOOM, B. M. 1985. Ethnopteridology of the Chácobo Indians in Amazonian Bolivia. Amer. Fern J. 75:19–21.

CAMINO, A. & JOHNS. T. 1988. Laki-Laki (Dennstaedtia glauca, Polypodiaceae): A Green Manure Used in Traditional Andean Agriculture. Economic Botany 42(1):45-53.

CHRISTENSEN, H. 1997. Uses of ferns in two indigenous communities in Sarawak, Malaysia. In JOHNS, R. J. (Ed.) Holttum Memorial Volume, pp. 177-192. Royal Botanic Gardens, Kew.

CHAI, T.-T., PANIRCHELLVUM, E., ONG, H.-C. & WONG, F.-C. 2012. Phenolic contents and antioxidant properties of *Stenochlaena palustris*, an edible medicinal fern. Botanical Studies 53: 439-446.

CHANG, H.C., HUANG, G.J., AGRAWAL, D.C., KUO, C.L., WU, C.R. & TSAY, H.S. 2007. Antioxidant activities and polyphenol contents of six folk medicinal ferns used as "Gusuibu". Bot. Stud. 48: 397-406.

CLINE, W. 1937. Mining and Metallurgy in Negro Africa. George Banta Pub. Co.: Menasha, Wisconsin.

DÍAZ DE LEÓN, M. E. M., MENDOZA-RUÍZ, A. & PÉREZ-GARCÍA, B. 2007. Usos de los helechos y plantas afines. Etnobiología 5: 117-125.

DIXIT, R.D. 1982. *Selaginella bryopteris* (L.) Bak. – An ethnobotanical study IV. J. Econ. Tax. Bot. 3: 309-312.

ELUTÉRIO, A.A. 2006. Management of tree fern (*Cyathea* spp.) for handicraft production in Cuetzalan, Mexico. Economic Botany 60: 182-191.

FILIPPINI, E.C.P., DUZ, S.R. & RANDI, Á.M. 1999. Light and storage on the germination of spores of *Dicksonia sellowiana* (Presl) Hook., Dicksoniaceae. Revta. Bras. Bot. 22: 21-26.

FRANCA, T. N., TOKARNIA, C. H. & PEIXOTO, P. V. 2002. Enfermidades determinadas pelo princípio radiomimético de *Pteridium aquilinum* (Polypodiaceae). Pesq. Vet. Brass. 22(3): 85-96.

FRYE, T. C. 1934. Ferns of the Northwest. Metropolitan Press, Portland.

GUMAELIUS, L., LAHNER, B., SALT, D. E. & BANKS, J. A. 2004. Arsenic

hyperaccumulation in gametophytes of *Pteris vittata*. A new model system for analysis of arsenic hyperaccumulation. Plant Physiol. 136:3198–3208.
HERNÁNDEZ CIBRIÁN, R. K. & SUTHERLAND, C. H. N. 2007. Etnobotánica de los Helechos de Honduras. Ceiba 48(1-2): 1-10.
HOUGHTON, P. 1978. Dental evidence for dietary variation in prehistoric New Zealand. Journal of the Polynesian Society 87(3): 257-263.
HURREL, J. A. & DE LA SOTA, E. R. 1996. Etnobotánica de las Pteridofitas de los Pastizales de altura de Santa Victoria (Salta, Argentina). Revista Mus La Plata (NS). Botánica 15(105): 353–364.
JONES, D. L. 1987. Encyclopaedia of Ferns. An Introduction to ferns. Their structure, biology, importance, cultivation and propagation. Lothian Publishing Company PTY LTD. Melbourne, Sydney, Auckland.
JOSHI, P. 1997. Ethnobotany of Pteridophytes of hilly districts of Uttar Pradesh, India. Indian Fern J. 14: 14-18.
JOSHI, P. 2011. Ecology and Medicinal Uses of *Helminthostachys zeylanica* (L.) Hook. "An endangered flora of India" reported at Foothills of Kumaun Himalaya (Kashipur), Uttarakhand. Researcher 3(4): 51-54.
KELLER, H.A., MEZA-TORRES, E.I. & PRANCE, G.T. 2011. Ethnopteridology of the Guaranis of Misiones Province, Argentina. Amer. Fern J. 101(3): 193-204.
KIRN, H.S. & KAPAHI, B.K. 2001. Ethnobotanical notes on some ferns and fern-allies of Jammu and Kashmir State, India. Indian Fern J. 18: 35-38.
KUMAR A. 2009. Antioxidant effect of *Adiantum capillus veneris* Linn. on human lymphocyte: an *in vitro* study. Journal of Cell and Tissue Research 9 (2): 1899-1902.
KUMARI, P., OTAGHVARI, A. M., GOVINDAPYARI, H., BAHUGUNA, Y. M. & UNIYAL, P. L. 2011. Some ethno-medicinally important Pteridophytes of India. Int. J. Med. Arom. Plants 1(1): 18-22.
KUMARPAL, S. 2013. Study of Activity of Some Medicinal Ferns of Darjeeling. International Journal of Scientific and Research Publications 3(8): 1-4.
LAI, H.Y. & LIM, Y.Y. 2011. Evaluation of Antioxidant Activities of the Methanolic Extracts of Selected Ferns in Malaysia. International Journal of Environmental Science and Development 2(6): 442-447.
LAI, H.Y., LIM, Y. Y. & KIM, K.H. 2010. *Blechnum Orientale* Linn - a fern with potential as antioxidant, anticancer and antibacterial agent. BMC Complementary and. Alternative Medicine, vol.10: 15.
LIU, Y., WUJISGULENG, W. & LONG, C. 2012. Food uses of ferns in China: a review. Acta Soc. Bot. Poloniae 81: 263-270. (52 species used)
LOOSER, G. & RODRÍGUEZ, R. 2004. Los helechos medicinales de Chile y sus nombres vulgares. Gayana Bot. 61(1): 1–5.
LUJÁN, M. C., MORERO, R., BONZANI, N. E. & BARBOZA, G. E. 2007. Sobre la identidad de algunos helechos medicinales que se comercializan en Córdoba (Argentina). Boletín Latinoamericano y del Caribe de Plantas Medicinales y Aromáticas 6(6): 376-377.
LUJÁN, M. C., MORERO, R. & BARBOZA, G. E. 2011. Estudios epidérmicos en helechos y licófitas medicinales de la Provincia de Córdoba, Argentina. Hoehnea 38(4): 609-659, 2 tab., 28 fig.
MABBERLEY, D.J. 2008. Mabberley's Plant-book, ed. 3: 690. Cambridge Univ. Press
MACAYA, J. 2004. Helechos nativos de Chile cultivados con fines ornamentales. Chloris Chilensis 7(1) URL: http://www.chlorischile.cl.
MACAYA, J. 2008. Helechos introducidos en Chile con fines ornamentales (parte I). Chloris Chilensis Año 11, N°2. URL: www.chlorischile.cl.

MACÍA, M.J. 2004. A comparison of useful Pteridophytes between two Amerindian Groups from amazonian Bolivia and Ecuador. Amer. Fern J. 94: 39-46.

MANNAR MANNAN, M., MARIDASS, M. & VICTOR, B. 2008. A Review on the Potential Uses of Ferns. Ethnobotanical Leaflets 12: 281-285.

MAY, L. W. 1978. The economic uses as associated folklore of ferns and fern allies. Bot. Rev. 44: 491-528.

MAZUMDER, P. B., MAZUMDER, B., CHOUDHURY, M D. & SHARMA, G.D. 2011. In Vitro Propagation of *Drynaria quercifolia* (L.) J. Sm., a Medicinal Fern. Assam University Journal of Science & Technology, Biological and Environmental Sciences 7(1): 79-83.

MERRILL, E. D. 1917. An interpretation of Rumphius's "Herbarium Amboinense". Manila Bureau of Printing.

MOLINA, M., REYES-GARCIA V. & PARDO-DE-SANTAYANA, M. 2009. Local knowledge and management of the Royal Fern (*Osmunda regalis* L.) in Northern Spain: Implications for Biodiversity Conservation. Amer. Fern J. 99 (1): 45–55.

MURILLO, M.T. 1983. Usos de los helechos en Suramérica con especial referencia a Colombia. Ed. Instituto de Ciencias Naturales, Biblioteca José Jerónimo Triana, N°5, 156 pp. Bogotá.

NAVARRETE, H., LEÓN, B., GONZALES, J., AVILES, D. K., SALAZAR LECARO, J., MELLADO, F., ALBAN, J. & ØLLGAARD, B. 2006. Helechos. In: MORAES R., M., ØLLGAARD, B., KVIST, L. P., BORCHSENIUS, F. & BALSLEV, H. (Eds.): Botánica Económica de los Andes Centrales. Universidad Mayor de San Andrés, La Paz, p: 385-411.

NOVELLINO, D. 2006. An introduction to basketry in Island Southeast Asia. Proceedings of the IVth International Congress of Ethnobotany (ICEB 2005), 2006: 621-625.

NWOSU, M. O. 2002. Ethnobotanical studies on some Pteridophytes of southern Nigeria. Econ. Bot. 56: 255–259.

ORTEGA, F. 1993. La etnobotánica de *Pteridium aquilinum* (L.) Kuhn en Venezuela y sus posibles riesgos asociados a la carcinogénesis. Medula 2 (3-4): 51-56.

PANDE, P.C. & PANGTEY, Y.P.S. 1987. Studies on ethnobotany –I. On some less known edible and economic ferns of Kumaun region of Western Himalaya. J. Econ. Tax. Bot. 11: 81-85.

PATRIC RAJA, D., JOHNSON, M., IRUDAYARAJ, V. & JANAKIRAMAN, N. 2012. Antimicrobial efficacy of selected ferns of Western Ghats, South India. International Journal of Current Pharmaceutical Research 4 (2): 58-60.

PRANCE, G. T. 1991. What is ethnobotany today? J. Ethno-pharmacol. 32: 209-216.

PRUDENTE, L. T. 2007. Arquitetura Mbyá-Guaraní na Mata Atlântica do Rio Grande do Sul. Estudo do caso do Tekoá Nhüu Porã. Tese (Mestrado) em engenharia. Universidades Federal do Rio Grande do Sul. Escola de Engenharia. Porto Alegre, 164 pp.

RATHINASABAPATHI, B., MA, L. Q. & SRIVASTAVA, M. 2006. Arsenic Hyperaccumulating Ferns and their Application to Phytoremediation of Arsenic Contaminated Sites. Floriculture, Ornamental and Plant Biotechnology 3: 304-311.

RECHENMACHER, C., SCHMITT, J. L. & BUDKE, J. C. 2007. Estrutura e distribuição espacial de uma população de *Blechnum tabulare* (Thunb.) Kuhn (Pteridophyta, Blechnaceae) em um mosaico floresta-campo no sul do Brasil. Pesquisas, Botânica 58: 177-186.

RICCO, R. A., AGUDELO, I., GARCÉS, M., EVELSON, P., WAGNER, M. L. & GURNI, A. A. 2011. Polifenoles y actividad antioxidante en *Equisetum giganteum* L.

(Equisetaceae). Boletín Latinoamericano y del Caribe de Plantas Medicinales y Aromáticas 10 (4): 325 – 332.

RUIZ, H. 1805. Memoria sobre la legítima calaguala y otras dos raíces que nos vienen de la América meridional. Imprenta de D. José del Collado, Madrid, 60 pp.

RUMPHIUS, G. E. 2011. The Ambonese Herbal vol 5: 121-165. English translation by E.M. BEEKMAN of The Ambonese herbal first published in 1741, Yale University Press.

SHARMA, B.D & VYAS, M.S. 1985. Ethnobotanical studies on the ferns and fern allies of Rajastan. Bull. Bot. Survey India 27: 1-4.

SCHMITT, J. L., SCHNEIDER, P. H. & WINDISCH, P. G. 2009. Crescimento do cáudice e fenologia de *Dicksonia sellowiana* Hook. (Dicksoniaceae) no sul do Brasil. Acta bot. bras. 23(1): 282-291.

SCHMIDT, P. R. & AVERY, D. H. 1983. More Evidence for an Advanced Prehistoric Iron Technology in Africa. Journal of Field Archaeology 10(4): 421-434.

SMITH, A. R., PRYER, K. M., SCHUETTPELZ, E., KORALL, P., SCHNEIDER, H. & WOLF, P. G. 2006. A classification for extant ferns. Taxon 55(3): 705-731.

SOARE, L. C., FERDEŞ, M., DELIU, I. & GIBEA, A. 2012. Studies regarding the antibacterial activity of some extracts of native pteridophytes. U.P.B. Sci. Bull., Series B 74(1): 21-26.

SRIVASTAVA, K. 2007. Importance of Ferns in Human Medicine. Ethnobotanical Leaflets 11: 231-234.

STEFAÑUK, M. Á. 2009. Diccionario geográfico toponímico de Misiones. Contratiempo Ediciones. Buenos Aires, 817 pp.

STRASBURGER, E., NOLL, F., SCHENCK, H. & SCHIMPER, A. F. W. 2003. Tratado de Botánica, 35ª edición, actualizada por SITTE, P., WEILER, E. W., KADEREIT, J. W., BRESINSKY, A. & KÖRNER, C. Ediciones Omega, Barcelona, 1134 pp.

THOMAS, T. 2011. Preliminary Antibacterial and Phytochemical Assessment of *Osmunda regalis* L. International Journal of Pharmaceutical & Biological Archives; 2(1): 559-562.

TURNER, N.J, JOHNSON GOTTESFELD, L.M., KUHNLEIN, H.V. & CESKA, A. 1992. Edible wood fern rootstocks of western North America: solving an ethnobotanical puzzle. J. Ethnobiol. 12: 1-34.

VETTER, J. 2011. Toxicological and medicinal aspects of the most frequent fern species, *Pteridium aquilinum* (L.) Kuhn. Chapter 25. In H. Fernández *et al.*, (eds.): Working with ferns: Issues and applications. Springer Sciences & Business Applications. P. 361.

WILEY, G. R. 2003. Archaeobotany: Scope and Significance . In: Richard Evans Schultes & Siri Von Reis (Eds.): Ethnobotany. Timber Press, Portland. P: 400-406.

ZHANG, Y. M. 2007. A preliminary investigation of the history of pteridophyte eating in China. Journal of Southwest Agricultural University (Social Science Edition) 5(4): 103–106.

ZHU, X., KUANG, Y., XI, D., LI, J. & WANG, F. 2013. Absorption of Hazardous Pollutants by a Medicinal Fern *Blechnum orientale* L., BioMed Research International Vol. 2013: 1-6.

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The authors in a Guarani village in Misiones, Héctor Keller at left, Ghillean Prance second from left.

NOTE ON THE REDISCOVERED TYPE SPECIMEN OF *ANGIOPTERIS INDICA* DESV. (MARATTIACEAE)

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Key words: *Angiopteris indica*, Herb. Desvaux, India, Marattiaceae, type.

ABSTRACT

The type of the tree fern *Angiopteris indica* Desv. (Marattiaceae) was rediscovered in Herb. Desvaux at P and its status is discussed.

INTRODUCTION

Three species of the marattioid fern genus *Angiopteris* Hoffm. (Marattiaceae) are generally accepted to occur in India (Fraser-Jenkins, 2008; Fraser-Jenkins & Benniamin 2010), namely *Angiopteris indica* Desv., *A. helferiana* C.Presl, and *A. palmiformis* (Cav.) C.Chr. Fraser-Jenkins (2008) accepted *A. indica* as the oldest available name for plants characterized by the combination of the following characters: the soral lines are located close or at the margin, the lamina segments possess prominent teeth near their tips, the lamina colour is darker than in other Indian species, and with the false (recurrent) veins reaching the soral line or just passing beyond it. In contrast, *A. helferiana* is distinguishable from *A. indica* by its inframarginal sori, whereas *A. palmiformis* has long false veins extended up to the pinnule-midrib.

Angiopteris indica was described by Desvaux in 1813 (Desvaux 1813: 267) and not in 1811 (Desvaux 1811: 207), as misquoted by Moore (1857: 75) and Christensen (1906: 57), but see Hooker & Greville (1831) for the correct citation of the name. In the protologue, Desvaux (1813: 267) described the plants as "frondibus pinnatis, pinnis lanceolatis utrinque attenuates" and mentioned the area of origin as "Habitat in India orientali". He further considered the non-cordiform base on the segments as the main feature distinguishing this species from previously described taxa. Desvaux in his protologue mentioned that he saw a specimen of the species at Herb. de Jussieu. Later authors (Vriese & Harting, 1853; Fraser-Jenkins, 2008) concluded that no specimens of this species were found in the Herb. de Jussieu, which is located in the herbarium at the "Museum national d'Histoire naturelle" at Paris (P).

Subsequently, Fraser-Jenkins (2008) designated a neotype: Herb. Wight e Nilghiry ["S. India"], alt. 5000 ped. Wallich List No. 187.8. (K-W). This designation is based on the crucial assumption that no specimen seen by Desvaux can be found.

RESULTS

Here, I present the discovery of a single specimen located at "Herbier de A.N. Desvaux Donné par Mme Vve Lavallée en 1896" in the herbarium P (Fig. 1A) with the barcode P01646217 (http://sonneratphoto.mnhn.fr/2010/08/09/4/P01646217.jpg). The specimen carries two labels on the left side that were interpreted as written by Desvaux showing the name "*Angiopteris indica* Desv., journ. bot. appl, p. 267, Habitat in India orientali" (Fig. 1D). The second label mentions (in French) "was not described in my memoir given at Berlin" (Fig. 1D). By this annotation Desvaux indicated that the name *A. indica* was

not published in "Berlin Magazine" in 1811 along with many new taxa he described there. A third label below the pinna fragment shows the name "*Angiopteris glauca* Desv." (Fig. 1B). This name does not correspond to *Angiopteris glauca* Alderw. Mal. Ferns, Suppl. I, Corr. 61 (1917) and it is interpreted here as an unpublished name considered by Desvaux.

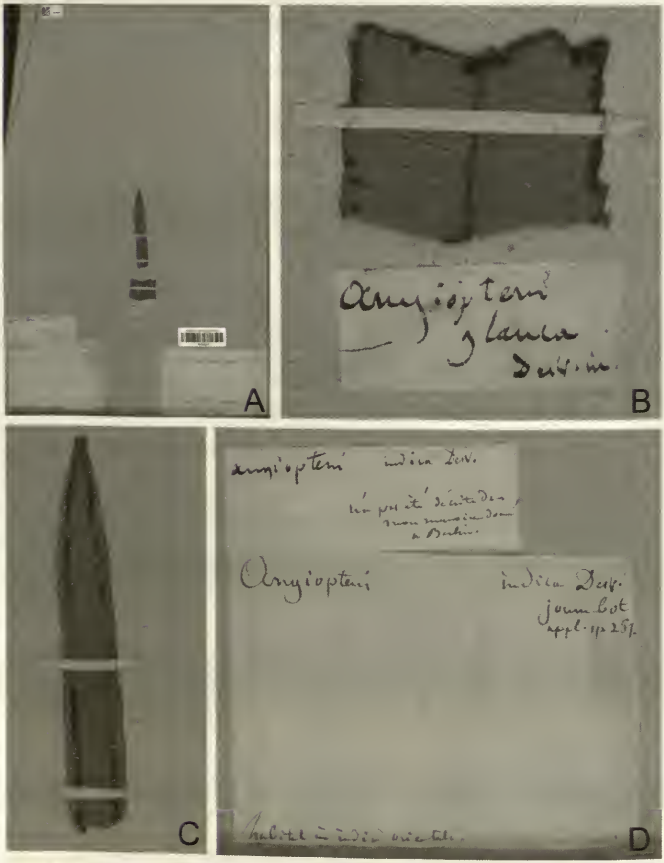

Figure 1. Specimens of *Angiopteris indica* Desv. A. Herbarium sheet (P01646217) with two pinnule-segments, B. fragmented pinnule (Type), C. second pinnule with long false veins, D. labels written by Desvaux. Images © Muséum national d'Histoire naturelle, Paris Herbarium (P), reproduced with permission.

The putative type is a fragment of pinnule showing prominent marginal teeth, inconspicuous false veins and sori inframarginal (Fig. 1B). A morphologically distinct second pinnule pasted above it (see Fig. 1A) has long false veins extended up to pinnule-midrib, rounded base and nearly median sori (Fig. 1C).

DISCUSSION

One of these pinnules should be considered as type of *A. indica* as it was definitely studied by Desvaux, supported by the evidence of his own handwritten labels, and which can be assumed to be the lost type of *A. indica* from Herb. de Jussieu.. The second pinnule (Fig. 1C) is not a separate portion of the same plant but was pasted from a different specimen (pinna): Java, *Leschenault 642* (barcode P01646218, http://sonneratphoto.mnhn.fr/2010/08/09/4/P01646218.jpg); Jean-Baptiste Leschenault was a French botanist and his plant collections from Java were subsequently used by A.L. de Jussieu and others. But there is no evidence to support the view that Desvaux selected this second pinnule (Fig. 1C) as type and pasted it himself. Actually the second pinnule was originally cut and pasted in an inverted position in P01646218. As a result it was easily detached and later erroneously pasted in P01646217.

Desvaux coined the name *A. glauca* Desv. probably due to glaucous lamina of the pinnule (Fig. 1B), but later revised it as *A. indica* considering the distribution "India Orientali," which includes modern India, Sri Lanka, Indonesia, Philippines and Marianas (Cook 2009).

CONCLUSION

The fragment of pinnule (Fig. 1B) is chosen here as the type of *A. indica* from the two pinnules in Figure 1A. This type, actually lectotype (designated here), refutes the application of the name *A. indica* to plants from India with marginal sori by Fraser-Jenkins (2008) in displaying inframarginal sori (Fig. 1B), similar to *A. helferiana* (having sori about 1 mm distant from margin). But due to wide range of morphological variability of species of *Angiopteris* further additional data are required to confirm the identity and correct number of species of *Angiopteris* in India.

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REFERENCES

CHRISTENSEN, C. 1906. Index Filicum. H. Hagerup, Copenhagen. 744 pp. (http://www.biodiversitylibrary.org/item/9241)

COOK, A. 2009. Linnaeus and Chinese plants: A test of the linguistic imperialism thesis. Notes Rec. R. Soc. (doi:10.1098/rsnr.2009.0051)

DESVAUX, N.A. 1811. Observations sur quelques nouveaux generes de fougères et sur plusieures espéces nouvelles de la meme famille. Berl. Mag. 5: 297-330. (http://babel.hathitrust.org/cgi/pt?id=hvd.32044106317993;view=1up;seq=218)

DESVAUX, N.A. 1813. Description de Fougères nouvelles. J. Bot. Agric. 1: 266-273. (http://gallica.bnf.fr/ark:/12148/bpt6k96848g)

FRASER-JENKINS, C.R. & BENNIAMIN, A. 2010 ["2009"]. Fifty rarities and additions to the pteridophytic flora of Arunachal Pradesh, N.E. India. Panjab University Research Journal (Science) 59: 1-38.

FRASER-JENKINS, C.R. 2008. Taxonomic revision of three hundred Indian subcontinental pteridophytes with a revised census-list. Bishen Singh Mahendra Pal Singh, Dehra Dun. 685 pp.

HOOKER, W.J. & GREVILLE, R.K. 1831. Icones Filicum. Vol. 1, Prostant Venales Apud Treuttel et Würtz, Treuttel Fil. et Richter etc., London. (http://dx.doi.org/10.5962/bhl.title.3867)

MOORE, T 1857. Index Filicum. W. Pamplin, London. 396 pp. (http://dx.doi.org/10.5962/bhl.title.19640)

VRIESE, W.H. DE & HARTING, P. 1853. Monographie des Marattiacées. Noothoven van Goor, Leiden & Arnz, Düsseldorf. 60 pp.

FIRST CHROMOSOME NUMBER REPORT FOR *CYSTOPTERIS FRAGILIS* (CYSTOPTERIDACEAE: PTERIDOPHYTA) IN IRAN

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ABSTRACT

The chromosome number and ploidy level of *Cystopteris fragilis* (L.) Bernh. are documented for the first time from Iran. The count was tetraploid, with 2n= 4x= 168. This agrees with previous reports of tetraploid *C. fragilis* from Europe, Asia and the United States.

INTRODUCTION

Cystopteris Bernh. (Cystopteridaceae) comprises about 27 species distributed throughout the temperate regions and tropical mountains (Rothfels *et al.,* 2013). Three species occur in Iran: *C. alpina* (Lamark) Desvaux, *C. dickieana* Sim and *C. fragilis* (L.) Bernh. (Roux 2001; Khoshravesh *et al.,* 2009). The two latter species have also been reported from high elevations in the Hindu Kush Mountains of neighboring Afghanistan (Breckle, 1987). In general, these species of *Cystopteris* are found in shady, rocky, wet habits (Bhellum and Razdan, 2012). The taxonomy and distribution of its species in Iran have been reported by Khoshravesh *et al.* (2009). *Cystopteris fragilis* differs from *C. dickieana* in having spiny spores (vs. verrucate in *C. dickieana*).

The chromosome numbers of n=84 and n=126 (tetra- and hexaploid, respectively) of *C. fragilis* were first reported from Europe (Manton, 1950). Vida (1976) later reported octaploids in Central Europe. In North America, tetraploids and hexaploids of *C. fragilis* have been found (Wagner, 1955; Haufler and Windham, 1991; Haufler *et al.;* 1995, Paler and Barrington, 1995). In Asia, tetraploids and hexaploids have been reported from India and Japan (Bhellum and Razdan, 2012; Mitui, 1970). In 2010, a pentaploid with 2n=210 was also recorded from Mongolia Altai by Kawakami *et al.* (2010). For Iran, however, chromosome numbers of *C. fragilis* have not been reported previously. This paper represents the first such report for the country.

MATERIAL AND METHODS

Fixed cytological material and voucher specimens were collected by the first author from three populations in natural habitats in Akhlamad waterfall valley, ca. 65 km NW of Mashhad, NE Iran at an elevation 1500 m in May and June 2013. The populations occurred on stony or rocky slopes exposed to waterfall, within shaded habitats, and occasionally in the cement of the roadside. Vouchers of examined specimens are deposited in IAUM and NY. Our initial identification was checked by comparison with descriptions in the floristic literature (Khoshravesh *et al.,* 2009) and confirmed by Robbin C. Moran at NY.

The chromosome squash method used followed that of Windham and Yatskievych (2003). Pinnae with whitish sporangia were collected every half hour from 9 am to 1 pm. The pinnae were fixed in Farmer's Solution (1:3 glacial acetic acid-ethyl alcohol) and

Carnoy's Solution (ethanol, glacial acetic acid and chloroform in the proportion of 6: 1: 3). Large numbers of sporangia were squashed in acetocarmine. Photography were taken with a digital camera Dino-Lite connected to Labomed LX 400 microscope.

RESULTS AND DISCUSSION

We found n=84 pairs (bivalents) at meiotic metaphase I (Figure 1). This is the first chromosome count of *C. fragilis* from Iran. This number agrees with previous counts from Jammu and Kashmir ((Bhellum and Razdan, 2012), Mongolian Altai (Kawakami *et al.,* 2010) in Asia; Finland, (Sorsa, 1961), and Iceland (Löve & Löve, 1943) in Europe; Ontario, British Columbia, and Greenland in Canada (Britton, 1953; Taylor and Mulligan, 1968; Dalgaard, 1989), and Michigan, USA (Wagner, 1955).

Each sorus contained 6–19 sporangia. The most important factor in obtaining meiotic figures at the proper stage was the time of fixation. Descriptions and the figures in the present paper refer to fixation at 11am. Tetrad spores were produced by the second meiotic division and many well filled, spiny spores were observed (Figure 2). The size of 25 spores from one leaf was measured in distilled water as followed: 38.48–48.60 × 23.40–28.65 mm. The size straddles that reported for tetraploids and hexaploids within *Cystopteris* by Blasdell (1963). He found that tetraploids had spore lengths from 32–42 mm and hexaploids from 38–48mm. It is not known what mounting media Blasdell used to measure his spores—whether distilled water, Hoyer's solution, or Canada balsam. Use of different mounting media might explain why our results of spore length measurements do not fall exactly within the tetraploid range reported by Blasdell (1963).

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REFERENCES

BHELLUM, B.L. & RAZDAN, B. 2012. *Cystopteris fragilis* f. *kashmiriensis*_Bhellum and Razdan- A new forma from India. International Journal of Scientific and Research Publication 2(4): 1– 4.

BLASDELL, R.F. 1963. A monographic study of the fern genus *Cystopteris*. Memoirs of the Torrey Botanical Club 21(4): 1–102.

BRAITHWAITE, A.F. 1964. A new type of apogamy in ferns. New Phytol. 63 (3): 293–305.

BRECKLE, S.-W. 1987. Distribution and ecology of *Cystopteris* (Athyriaceae) Within the Flora Iranica region. Plant Syst Evol. 155: 59–69.

BRITTON, D.M. 1953. Chromosome studies on ferns. Am J Bot. 40: 575–583.

DALGAARD, V. 1989. Additional chromosome numbers in vascular plants from the Disko Bugt area (west Greenland). Willdenowia 19: 199–213.

HAUFLER, C.H., MORAN, R.C., & WINDHAM, M.D. 1995. *Cystopteris*. Pages 263–270. *In:* Flora of North America Editorial Committee, editors. Flora of North America, volume 2. Pteridophytes and Gymnosperms. Oxford University Press, New York.

HAUFLER, C.H. & WINDHAM, M.D. 1991. New species of North American *Cystopteris* and *Polypodium*, with comments on their reticulate relationship. Am Fern J. 81: 7–23.

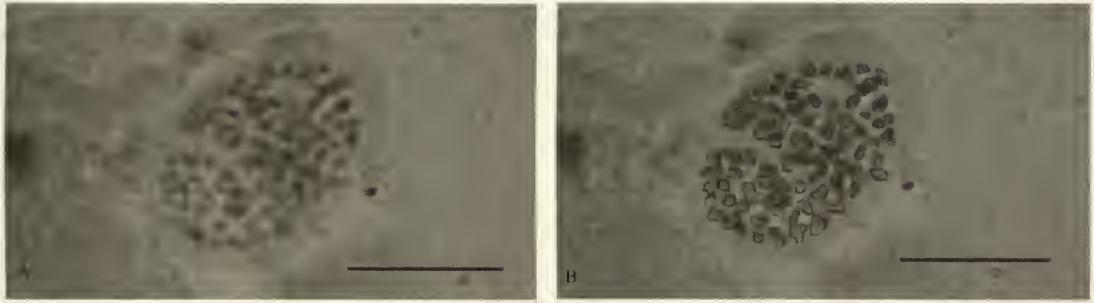

Figure 1. A. Chromosomes of *C. fragilis* at meiosis, *n*= 168; **B.** Explanatory diagram for a, showing 84 bivalents. Scale bars= 20 µm.

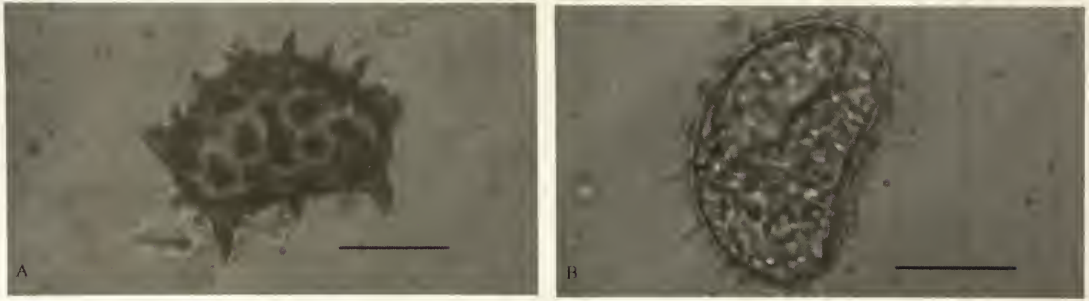

Figure 2. Surface (**A**) and internal (**B**) features of spiny spores of tetraploid C. *fragilis*. Scale bar= 20 µm.

KAWAKAMI, S.M., KAWAKAMI, S., KATO, J., KONDO, K., SMIRNOV, S.V. & DAMDINSUREN, O. 2010. Cytological study of a fern *Cystopteris fragilis* in Mongolian Altai. Chromosome Botany 5: 1–3.

KHOSHRAVESH, R., AKHANI, H. & GREUTER, W. 2009. Ferns and fern allies of Iran. Rostaniha (Botanical Journal of Iran) 10 (1): 1–129.

LÖVE, A., LÖVE, D. 1943. The significance of differences in the distribution of diploids and polyploids. Hereditas 29: 145-163.

MANTON, I. 1950. Problems of cytology and evolution in the Pteridophyta. Cambridge: University Press. London. 316 Pp.

MITUI, K. 1970. Chromosome studies on Japanese ferns. Japanese Journal of Botany 45: 84–90.

PALER, M.H. & BARRINGTON, D.S. 1995. The hybrid *Cystopteris fragilis* × *C. tenuis* (Dryopteridaceae) and the relationship between its tetraploid progenitors. Syst Bot. 20: 528–545.

ROTHFELS, C., WINDHAM, M.D. & PRYER, K.M. 2013. A plastid phylogeny of the cosmopolitan fern family Cystopteridaceae (Polypodiopsida). SystBot. 38: 259–306.

ROUX, J. P. 2001. Conspectus of southern African Pteridophyta. ABC Press, Epping Ind., Cape Town. 223 Pp.

SORSA, V. 1961. Chromosome studies on Finish Pteridophyta II. Hereditas 47: 480–488.

TAYLOR, J.A., & MULLIGAN, G.C. 1968. Flora of the Queen Charlotte islands. Part 2: Cytological aspects of the vascular plants. Canada Department of Agriculture Press, first edition. 659 Pp.

WAGNER, W.H. 1955. Cytotaxonomic observations on North American ferns. Rhodora 57: 219–240.

WINDHAM, M.D., & YATSKIEVYCH, G. 2003. Chromosome studies of cheilanthoid ferns (Pteridaceae: Cheilanthoideae) from the western United States and Mexico. Am J of Bot. 90: 1788–1800.

THE DUTCH RUSH: HISTORY AND MYTH OF THE *EQUISETUM* TRADE

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Key words: *Equisetum hyemale*, economic botany, ethnopteridology, trade history

ABSTRACT

In England in the early 19th century at least two products went by the commercial name Dutch Rush, *viz.* the Rough Horsetail *Equisetum hyemale* L. used in cabinet making and similar crafts, and the Common Club-rush/Bulrush *Schoenoplectus lacustris* (L.) Palla used in matting and chair manufacturing. Some authors did not heed the scientific names and confused the properties and geo-cultural backgrounds of both products. Thus the myth took hold that *E. hyemale* was in culture in the Netherlands and that is was deliberately planted and cared for to protect that country from the sea. Scarce but widespread evidence of trade reveals that this species was economically insignificant. The idea that it owes its common name to imports from Holland could be correct; however, other parts of North and Central Europe, especially the upper Rhine Valley, are more likely to be the original sources from where the Dutch obtained the plants. North America can be reasoned to be an alternative origin, but evidence for this hypothesis is still lacking.

INTRODUCTION

Ever since the sixteenth century, many authors in a number of Western European countries have reported the use of *Equisetum hyemale* L. by various trades (e.g. Fuchs, 1543; Gerarde, 1597; Bock & Sebisch, 1630; Pexenfelder, 1670; Ruppe & Haller, 1745; Anon., 1749; Pernety, 1771; Krünitz, 1785; J. E. Smith, 1802; Headrick, 1813; Stewart, 1815; Phillips, 1818; Hooker, 1821; Gill, 1822). Material evidence of its use is found in inventories of workshops (e.g. Giskes, 1979) and characteristic scratches from its siliceous skin on antique woodcraft (Esterly, 1998). In addition, several authors during the past two centuries showed that the vernacular name "Dutch Rush" used in England relates to large-scale imports from Holland[1] (Pratt, 1846; Francis, 1851; Johnson & Sowerby, 1856; Moore, 1861; Pratt, 1866). Up to the present day the statement is repeated frequently (Weeda *et al.*, 1985; Øllgaard & Tind, 1993; Page, 1997). The apparent source to which this can be traced back is Edward Newman (Newman, 1842, 1844), who also noted that the species was cultured in Holland and played an important role in the defence of the coast against the eroding action of the sea:

"... for this purpose it is imported, under the name of "Dutch Rush" in large quantities, from Holland, where it is grown on the banks of canals and on the sea ramparts, which are often bound together and consolidated by its strong and matted roots."

[1]Wherever the toponym Holland is used, literal citations excepted, it is to be understood in the strict sense, i.e. the western part of the Netherlands, or the present provinces Noord-Holland and Zuid-Holland.

Table 1. Vernacular names used in British English

Name	Source
Shave-grass	(discussion in this paper)
Dutch Rush	(discussion in this paper)
Rough horsetail	From the French/Latin *asprella* (de Winter, 2012), introduction unknown
Dutch shave-grass	species list of Scarborough (Hinderwell, 1811)
Holland rushes	In advertisements (Glover, 1843; Measom, 1861)
Dutch reed	rarely (Bailey, 1756; Martin, 1813; Henslow, 1839; Trimmer, 1842)
polishing rushes	customs' duties lists (Burn *et al.*, 1831; Parnell, 1831; Ellis, 1837)
shave weed	(Aubrey, 1848)
shauynge gyrs	(Turner, 1538)
dyßhewaßhynges	(Turner, 1538)
Pewterwort	e.g. (Withering, 1776; Targioni Tozzetti, 1813; Wilkinson, 1858)
scouring[-]rush	American (Law Olmstedt *et al.*, 1924)

This is at odds with the ecological preferences of the species, as well as with both its historical and present day distribution (de Winter, 2007). These problems can be summarised under three main points:

1. the alleged abundance of *E. hyemale* in Holland finds no evidence in its current distribution in that country, nor is it supported in historical Dutch reports;
2. the reported occurrence and even cultivation of *E. hyemale* along canals and the practice of using it for the solidification of dykes, dunes, or any kind of coastal protection constructions finds no reference in Dutch literature, nor in the present distribution and habitat preferences of European *E. hyemale*;
3. the plant detailed by Newman by its size and number of ridges suggests American *E. hyemale* subsp. *affine* (Engelm.) Calder & Roy L.Taylor rather than European *E. hyemale* subsp. *hyemale*, which casts doubt on the continental origin of the merchandise.

If these doubts are well-founded, then the question must be addressed as to whether *E. hyemale* really was imported from Holland to England, and where the origin should be sought of the plants sold on London markets.

HISTORY OF THE NAME "DUTCH RUSH"

A number of vernacular names have been used for *E. hyemale* in English, but most of them never became popular and have disappeared into oblivion (Table 1). The oldest historic one is "shave-grass", which was first recorded in the 14th century: "*Cauda equina, cauda Caballina idem est. angl,* schauegres" (Anon., 1350-1400; Lancaster, 1887; Murray, 1971). To *shave* is derived from the Anglo-Saxon *scafan* through the Old English *shaven*, and Middle English *schaven/schafen* (Flexner & Hauck, 1993), whence there is a direct relation with the Old High German *scafthawi* (Graff, 1838) and the Dutch stem *schaaf-* as in *schaafstro* (de Winter, 2012). Although the verb "to shave" at present is predominantly used to refer to the process of removing the beard, the general meaning is to make a surface smooth (Webster, 1913). The name is continuous through Turner (1538) and Gerard (1597). "Shave-grass" has been largely replaced now by the more official "rough horse-tail" (Bolton, 1790; J. E. Smith, 1802), and "Dutch Rush".

The latter name has been in use since around 1700 and first appears in manuals of practical trades (C.K., 1701; Artlove, 1730; Barrow, 1735; Anon., 1754; Dossie, 1758). Eighteenth century dictionaries show a more conservative attitude towards this emerging name and strictly print "shave-grass". The name "Dutch Rush" therefore remains dormant in written language until the second edition of the cryptogamic volume of William Withering's *Botanical Arrangement* was published (Withering, 1792), in which the name "Dutch Rush" is used equivalent to "Shave-grass". The *Botanical Arrangement* was an immediate and sustained success that would see many reprints (Lee, 2001). Inclusion in this work apparently made the name "official" and acceptable for use in subsequent publications (Figure 1). This pattern strongly suggests that since the onset of the eighteenth century something has changed that made people name the product by its origin rather than its purpose. Just assuming that the increasing trade with the low countries flooded the market with Dutch horsetails seems unsatisfactory as an explanation. A size and/or quality difference as suggested by Newman might have changed the perception and initiated the desire to distinguish the new product by name.

IMPORTS OF HORSETAILS INTO BRITAIN

Even though *E. hyemale* is not especially rare in Britain (Wardlaw & Leonard, 2005), it was certainly felt so (Camden, 1722; James, 1745). Since urbanisation and industrialization in England started long before the invention and acceptance of sand paper in the mid 19th century, it is conceivable that here, more than elsewhere in Europe, the discrepancy was felt between urban demand and rural supply. Especially the reconstruction of London after the fire (1666) may have elevated the demand.

The earliest account of exports from the Netherlands are found in a manuscript of the late 17th century by John Aubrey (Aubrey, 1847): "Watchmakers and fine workers in brasse use it after smooth filing. They have it from Holland". This can be dated more exactly, for in a letter to John Ray of August 5, 1691 he writes: "Shave-weed used by artists (which they have from Holland)" (Aubrey, 1848).

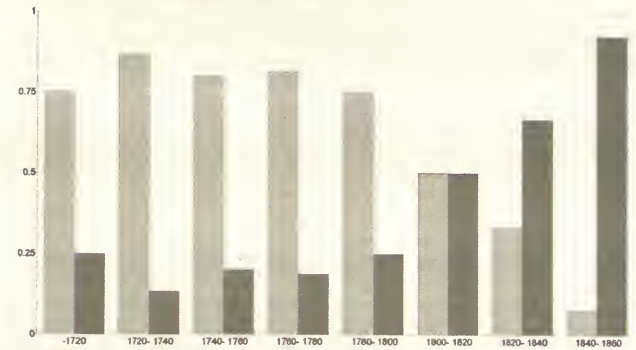

Figure 1. Relative usage of the names "Dutch Rush" (darker bars) and "Shave-grass" (lighter bars) in English literature from 1720-1860. Counts made per 20 years periods, based on 178 printed publications, not including advertising.

The demand declined when glass paper came into use, but it never completely disappeared. In the USA it was still advertised in 1938 (Kaliban's Grocery and Market, 1938). Nowadays some still prefer it to scrape their clarinet reeds (Intravaia & Resnick, 1965; Taillard & Dalmont, 2012).

Testimony of imports into England, which lasted more than one and a half centuries, exists in lists of import duties of the English customs (Burn *et al.*, 1831; Parnell, 1831; Ellis, 1837), but is absent in earlier legislation (e.g. Steel, 1796). Often the horsetails could be imported, transported, and exported tax-free (de Martens & Murhard, 1836; Anon., 1837; MacGregor, 1843; Anon., 1849a, 1853, 1858) or they were not considered important enough to justify their own category (Koninkrijk der Nederlanden, 1816, 1822). As a consequence, no accounts of their trade were kept and they do not show in yearly statistical surveys (Departement van Financiën, 1848). England and Holland were the two countries with the worst kept statistics on agriculture and trade (MacGregor, 1843). Yet, although far from complete, a few statistics of the early period remain, covering the imports into the port of London and allowing sampling of the existing data of imports of *E. hyemale*. However, in all of them the horsetail trade is conspicuous by its absence, *viz.* in January 1683 (Houghton, 1728), from May to October 1735 (Anon., 1735), and from January to June, 1776 (Whitworth, 1777b, 1777a).

In the nineteenth century Dutch newspapers meticulously reported freight loaded and unloaded per port, frequently even per ship. Any product of trade of any importance would be expected to be listed. Nonetheless horsetails are not mentioned by any of their known names. With one exception, however: in the second half of 1855, 142 inland navigation barges with in total 6050 bundles of shave-grass arrived in Brussels (Anon., 1856). Estimating the total volume of *Equisetum* transported requires acquaintance with the size of such a bundle, which we do not know. A rough estimate for a bundle of 80 cm perimeter (as is used at present for bulrushes: de Vries, 2008) would be 500 – 1000 stems. Given that dense stands have 200 – 500 stems per m^2 (Rutz & Farrar, 1984), the annual production for Brussels only would have required the depletion of c. 0.6 – 3 ha. Such small amounts could easily have been found on Belgian territory, but apparently for reasons of quality or cost, long-distance transport per ship was more attractive.

In the mid-nineteenth century, exports of reeds and rushes to Britain exceeded those to Belgium by about 50% (Departement van Financiën, 1848) and if the export of horsetail may be estimated proportionally to this, the economic value must have been insignificant. John Yeats, an English commercial-geographer, who lived in Holland in 1845/46, compares *E. hyemale*, which "is occasionally imported from Holland" with *Scirpus lacustris* L. (now *Schoenoplectus lacustris* (L.) Palla), saying that "Many vessels laden with this rush arrive annually in England from Holland and Belgium, bringing thirty or forty tons of rushes each voyage. This is a very large quantity considering the lightness of the material. More than 1,000 tons of bulrushes are annually imported into the United Kingdom" (Yeats, 1870). It should be noted, though, that these figures stem from the second half of the nineteenth century, when the use of *E. hyemale* was already on the decline in favour of sandpaper, of which mass production in London had started by 1833. But also much earlier, in 1827, international horsetail trade was but marginal. From an example record of the net produce of customs duties it can be deduced that the total value of polishing rushes legally imported into Britain must have been £13.25 for that year (Parnell, 1830).

CULTIVATION AND CARE IN HOLLAND: COAST PROTECTION

Newman's statement, that the Dutch grew *E. hyemale* "on the sea ramparts, which are often bound together and consolidated by its strong and matted roots" (Newman, 1844), is repeated with slight variations in later literature. The authors obviously have copied each other in sequence, rephrasing the allegation without adding new observations:

"it is grown on the banks of canals and on the sea ramparts, which are often bound together and consolidated by its strong and matted roots" (Newman, 1844)

"The Dutch are well acquainted with the value of its long and matted roots in restraining the wasting effects of the ocean, which would soon undermine their dykes were it not for the *Equisetum hyemale* which is planted upon them" (Francis, 1851)

"the plant is of immense value in its native country from the extraordinary length and interlaced growth of its root-fibres, which mat together and consolidate the loose and swampy soil in which they grow, and thus form one of the most effectual water-dams of so level a land." (Wilkinson, 1858)

"this species is planted to support embankments, which it does by means of its branching underground stems" (Moore, 1861)

Along long stretches of the coast of Belgium and Holland, and the outward coasts of the islands in the North, belts of natural and semi-natural sand dunes protect the country from the sea. The hybrid *E.* × *moorei* Newman (*E. hyemale* × *E. ramosissimum* Desf.) is found in great numbers at several locations in the dunes of Zuid-Holland and southern Noord-Holland. It was first reported by Du Mortier in 1825 (as *E. trachyodon* A.Br.) near Beverwijk (Du Mortier, 1869), where it still can be found today. It is locally abundant between Scheveningen and Hook of Holland, where it has been known since the late 18th century (Anon., 1796; van Hall *et al.*, 1832). It is surprising that J.E. Smith (1793) did not note it when visiting the place. Leiden (L) has a number of specimens collected in the West of Holland during the 19th century; however, until 1870, when the first collection was made from the fore-dunes south of Scheveningen, all the collections originate from the interior dunes around Haarlem.

In 1797, Jan Kops set out to report on the state of the dunes of Holland. He was an eager botanist, paid special attention to any plants that could be used to control shifting sand and, as an agronomist working for the ministry, was also keen to find plants that could be made profitable in any way (Baert, 1943). If Newman with "the consolidation of sea ramparts" referred to the fixation of shifting sands in the dunes, it is hard to imagine that this would have escaped Kops's attention. Yet Kops explicitly states that no other means are known to him to fix the dunes than marram (*Ammophila arenaria* (L.) Link), straw, and reed mats (Kops, 1798; van Eys *et al.*, 1799). Neither earlier (Montin, 1771; Le Francq van Berkheij, 1780; van Geuns, 1789) nor later authors (Spengler, 1891; Vuyck, 1898) of technical treatments about sand fixation mention *Equisetum* for this purpose, even though Le Francq van Berkheij lists "Paardestaart, *Equisetum*" among the plants of the fore-dunes. Despite the present abundance of the hybrid in the dunes of southern Holland never, from the 18th century to the present, has its distribution been said to be deliberately promoted by man, and the remarks of Francis and Newman above cannot be attributed to it.

Where dunes are weak or absent, dykes have been built to protect the land, as in the topographically complex estuarine area of Zeeland and Zuid-Holland, along the rivers, along the entire coast of the Wadden Sea, and, before 1932, along the Zuiderzee and its inlets. Sea-dykes must be protected by a hard surface since no vascular plant can form mats firm enough to protect the dyke's surface from the action of the waves. At the onset of the 19th century such hard-shells were not yet customary.

Reed and rushes were recognised as effective agents to break the action of the waves and to prevent erosion of the banks of lakes (Meese, 1768), but they grow neither in seawater, nor at the high water limits of rivers. Sea-dykes were protected by stapling bundles of straw, eelgrass and rushes to the dyke-surface to form a soft shell that had to be renewed every autumn (Bréval, 1726; Schraver, 1807).

Inland river dykes consist of a core of sand or clay, covered with a water resistant layer of clay and finished with a grass-covered top layer (Fliervoet, 1992). Mats of superficially rooting herbs protect the surface against erosion, but deep-rooting plants weaken the construction (de Haan *et al.*, 2001; 2003) and can perforate the water resistant clay mantle (Technische Adviescommissie voor de Waterkeringen, 1985), without adding much to the stability (Sykora & Liebrand, 1987). High growing dense stands of *E. hyemale* could outcompete lower herbs that offer better protection. Finally, frequently grazed or mown low vegetation is less than optimal for this woodland species and at present it is not found on dykes, nor are there collections in the National Herbarium from such places. The hybrid *E.* × *moorei* has a number of stations along the river Rhine, but it is still rare on dykes. Altogether both technical and historical evidence for Newman's statement appear to be entirely lacking.

OVER-REPORTING OF DUTCH RUSH DUE TO DUTCH RUSHES

The likely source of the delusion is the 18th century bestseller, *The Gardeners Dictionary* (Miller, 1754, *Ed. 4*) that depicts how species of rush "grow on the Sea-shores, where they are frequently watered by the Salt-water. These two Sorts[2] are planted with great Care on the Banks of the Sea in Holland, in order to prevent the Water from washing away the Earth; which, being very loose, would be in Danger of removing every Tide, if it were not for the Roots of these Rushes; which fasten themselves very deep in the Ground, and mat themselves near the Surface, so as to hold the Earth closely together. Therefore, whenever the Roots of these Rushes are destroyed, the Inhabitants immediately repair them to prevent farther Damage." This paragraph is quoted from the section on *Juncus* as "*Juncus acutus*".

Miller must have meant the glaucous bulrush *Schoenoplectus tabernaemontani* (C.C. Gmelin) Palla that was cultured in great numbers in the brackish water of the Maas estuary, and possibly to some extent *S. maritimus* (L.) Lye, which was not cultured, but common in the more seaward parts of the estuary and known for its even greater capacity of promoting the sedimentation rate of silt than the former (Clevering & van Gulik, 1990; Weeda *et al.*, 1994).

Miller's handbook on wild and cultivated plants went into eight editions[3], and was copied (e.g. MacFarquhar & Gleig, 1797; Knight, 1833), and translated into French, German and Dutch. As Miller's text was copied over and over during more than a century, gradually elements changed, and new ones slipped in (Table 2).

Noteworthy is Loudon's addition that combines the name Dutch rush, and its usability for scouring metals (Loudon, 1829). Rushes (for making chairs) were imported from the Netherlands into England in large quantities (Yeats, 1870). Inevitably, they were

[2]i.e. *Juncus acutus, capitulis sorghi* C.B.P. & *J. acutus maritimus Anglicus* Park.

[3]Cited here is the fourth edition of 1754, but essentially the same text is found in the Dutch translation of 1745 (Miller, 1745) and therefore in earlier English editions not seen by the author.

Table 2. The evolution of Miller's account on bulrush-culture to Newman's account of *E. hyemale*

Period	Interpretation
1724 to 1754	The first and second Sorts grow on the Sea Shores, where they are frequently washed by the Salt Water. These two Sorts are planted with great Care on the Banks of the Sea in *Holland,* in order to prevent the Water from washing away the Earth; which, being very loose, would be in Danger of removing every Tide, if it were not for the Roots of these Rushes; which fasten themselves very deep in the Ground, and mat themselves near the Surface, so as to hold the Earth closely together. Therefore, whenever the Roots of these Rushes are destroyed, the Inhabitants immediately repair them to prevent farther Damage. In the Summer-time, when the Rushes are fully grown, the Inhabitants cut them, and tie them up into Bundles, which are dried, and afterward carried into the larger Towns and Cities, where they are wrought into Baskets, and several other useful Things, which are frequently sent into *England.* These Sorts do not grow so strong in *England,* as they do on the *Maese,* and some other Places in *Holland,* where I have seen them upward of four Feet high (Miller, 1754).
1797	The *conglomeratus,* and *acutus* or marine rush, are planted with great care on the banks of the sea in Holland (MacFarquhar & Gleig, 1797)
1829	*J. acutus* and *maritimus* are planted on the sea-embankments of Holland, and also in some parts of our own coasts, and in America. The roots run deep into the sand, and form a matted body which holds it together. In Holland, when the plants are fully grown and in flower, they are cut down, dried, and bound up like corn. The *J. acutus,* being very rough, is used for scouring copper and other vessels, and is one of the plants imported into this country for that purpose, under the name of the Dutch rush. The other species, and often both, are plaited into mats, baskets, chair-bottoms, ropes, etc. (Loudon, 1829)
1833	(...) are made of bulrushes; these grow in this country, naturally but not very commonly, in deep slow streams. The demand for them is greater than the home supply, and a considerable quantity is imported from Holland. (Society for the Diffusion of Useful Knowledge, 1833)
1842	*Equisetum hyemale:* for this purpose it is imported, under the name of " Dutch Rush," in large quantities, from Holland, where it is grown on the banks of canals and on the sea ramparts, which are often bound together and consolidated by its strong and matted roots. Bundles of this imported Dutch Rush are exposed for sale by many London shopkeepers. (Newman, 1842)

sometimes designated as "Dutch rushes", an adjective combination that never made it to a taxonym.

Traders used the name indiscriminately for both *E. hyemale* and *Schoenoplectus.* In advertising in the first half of the century, it is rarely made explicit which kind of rush is offered (e.g. "Dutch polishing rushes" or "Dutch bull rushes"). In less than half of such advertisements the context, such as chairmakers' or cabinet-makers', revealed the nature of the product offered (Table 3). It must have been this ambiguous use of the name that

Table 3. Advertisements with "Dutch Rushes" or "Holland Rushes" from before 1850.

Advertisements where product defined as:	Number
Equisetum	4
Schoenoplectus	8
Unknown	13
Total	25

Sources: *Bury and Norwich Post*: 29 Nov 1815; *Carlisle Journal*: 09 Mar 1833, 24 Aug 1833; *Carlisle Patriot*: 28 Oct 1820; *Chelmsford Chronicle*: 03 Oct 1783; *Chester Chronicle*: 23 Mar 1849; *Hampshire Advertiser*: 15 *Sep* 1832; *Hampshire Chronicle*: 26 Jul 1819 2x; *Hampshire Telegraph and Sussex Chronicle*: 23 Jul 1832; *Hampshire Telegraph*: 02 Mar 1829, 25 Apr 1831; *Hull Packet*: 07 Jan 1801, 03 Mar 1801, 27 Feb 1835; *Kentish Gazette*: 07 Jan 1845; *Liverpool Mercury*: 13 Jun 1823, 17 May 1844; *Norfolk Chronicle*: 09 Dec 1815; *Salisbury and Winchester Journal*: 19 Sep 1803, 26 Feb 1821; *Stamford Mercury*: 21 Apr 1848; *The Ipswich Journal*: 22 Jun 1805, 14 Sep 1805; *The Times*: 08 Sep 1831

led Newman to his misunderstanding. Evidently, when writing about *E. hyemale,* he did not make the distinction and copied unreliable sources without checking.

CULTIVATION AND CARE IN HOLLAND: HARVESTING FOR EXPORT

Whereas in English literature it is often stated that Dutch Rushes were cultivated and exported by the Dutch (Newman, 1842, 1844; Francis, 1851; Moore, 1861; Pratt, 1866), the continental literature remains almost taciturn about any culturing activities. The earliest mention of such a trade in Dutch literature is found in the *Flora Batava* (Kops & Van der Trappen, 1846), published shortly after Newman's publication in The Phytologist (Newman, 1842).

In the Netherlands, *E. hyemale* is not an abundant species. In the east of the country several healthy populations exist, but it is hard to imagine that these could have supported prolonged harvesting for both domestic and export markets. In Holland in the strict sense, i.e. the western part, *E. hyemale* is virtually absent, but the hybrid *E.* × *moorei* is quite common in the dunes and along railroads (de Winter & Lubienski, 2012). It would be conceivable that present day populations are not representative for the abundance in the 18th and 19th century. Both habitat destruction and harvesting might have caused such a decline. De Gorter (1781) had found the species in forests in the county Zutphen and Kops & Van der Trappen (loc. cit.) say it is abundantly found near Zutphen, at a number of locations in the West, the latter almost certainly to be attributed to the hybrid, and at some riverine locations for many of which the same applies. In the 17th century, Comelin (1683) saw it in stagnant-water ditches near the river Vecht near "*den Bergh*"[4], at the border of the firm, sandy soil of Utrecht and the fen areas of Holland.

E. hyemale is a species of moist woodlands. The area of woodland in the Netherlands has not declined since 1800, but has actually increased (Bijlsma, 2003), as before that time much had been cleared. Older sources often associate the species with ditches rather than woodland, which may be explained by its habit of persisting long after the trees

[4]presumably Nederhorst den Berg, about 25km SE. of Amsterdam

have been felled. Altogether it seems unlikely that the magnitude of the population would have permitted large scale harvesting to support an export trade over a long time and it must be questioned whether this country has ever been the source of such trade.

Comelin (loc. cit.) noted that at *den Bergh* it was collected for tumers to polish with it[5]. But later, from 1806, a number of annual reports have been compiled about the Dutch agriculture, including products gathered from uncultivated lands, such as reed (*Phragmites*), rushes (*Schoenoplectus*) and herbs (Kops, 1807, 1808, 1809, 1816, 1819, 1821, 1822c, 1822b, 1822a, 1829). No mention is made of any production or harvesting of Equisetums.

Nozeman (1783) expresses his amazement that *E. hyemale* is imported into the Netherlands from Spain (see below), rather than collected from local stocks. Subsequent botanists agree: "This plant does grow in some places of our home country, in woods and sandy lands, but it is, as far as I have been able to find out, not used" (van Hall, 1854).

"The shave-grass that the cabinet-makers use does not originate from our land, but is imported from elsewhere. From [the Netherlands] it is further transported to England, where it, completely undeserved, is designated by the name Dutch Rushes"(Oudemans, 1862; likewise: de Vries *et al.*, 1870).

An interesting phenomenon is that, analogous to the English "Dutch Rush", in the Netherlands it was sometimes called "Spanish rush" (Noel Chomel & De Chalmot, 1778; Van Meerten-Schilperoort, 1830; 1843; van Hall, 1843). The epithet "Spanish" intermittently used in the Dutch names of the species does not indicate a Spanish origin. Though it is found in Spain (Prada, 1986; Salvo Tierra, 1990), it occurs too infrequently to allow any significant yield (C. Fraser-Jenkins, pers. com.). Also, historically and regionally the predicate has been applied to at least thirty other species (Heukels, 1907), which seem to have little in common, though for quite a few of them it might be interpreted as "conspicuous" or "foreign".

A few authors hold the view that that the Netherlands does or could produce commercial horsetails: "This wood [Zalkerbos] also furnishes very good shave-grasses to polish wood" (van der Aa, 1851), without revealing his source nor the scale of the exploitation. In almanacs beggar boys were urged to collect shave-grass (among other products of nature) to earn their own living (Heldring *et al.*, 1837; Heldring, 1845). This may denote more about the low value and little enthusiasm to collect the stems in the Netherlands. Altogether, the conclusion seems justified that if Dutch-produced horsetails were ever imported into England, this must have taken place longer ago than the memory of the 19th century writers cited above, therefore no later than the first half of the 18th century.

CONTINENTAL TRADE AND ORIGIN OF THE SPECIES

Even if the plants have never been cultivated in the Netherlands, nor commercially harvested from the wild, it is still possible that Dutch traders imported them into London from other continental or overseas sources. The question then is where they would have originated.

There is evidence of horsetail trade elsewhere in Europe. Tariffs of the Zollverein

[5]Comelin's habitat description is more typical for *E. fluviatile* L. with which *E. hyemale* was often confused, and so was his description: *Equisetum foliis nudum, non ramosum sive junceum.* B. pin. *Hippuris foliis &* nuda Tab. *Equisetum majus aquaticum prim. icon* J. Bauh. Belg. *Groot Paarde-staart.* However, his observation on collecting the plant shows that he was at least partially correct.

(customs union, 1818-1871) name *Schachtelhalm* in near complete lists of items transported through the German lands (Anon., 1824; de Martens & Murhard, 1836; Anon., 1849a, 1849b, 1853, 1858). Likewise, Russia levied a small duty on horsetails (MacGregor, 1850), as did Norway, (Arntzen, 1830), France (Dujardin-Sailly, 1813) and Austria (Klenner, 1822; Anon., 1824, 1838), whereas Illyria (Anon., 1836) let them pass for free.

A number of more incidental sources can be found too. According to an early 19th century encyclopedia, *E. hyemale* was a lucrative product and exports from the southern French department *Bouches-du-Rhone* amounted to 10,000 francs annually (Leman, 1826). The amount in francs suggests the figure applies to statistics postdating 1795, when this currency had been introduced. The 1802 overview of this department, however, makes no mention at all of such an export (Michel, 1802). Moreover, it is stated that the department is very poor in woodland, a condition that has not changed to the present, and this explains the near absence of *E. hyemale* in those parts (J. le Paslier & C. Déliry, pers. com.). Duval-Jouve also expressed his doubt about the figures he had from de Villeneuve (de Villeneuve, 1821), but after investigating the matter he found that they referred to *E. ramosissimum* and *E. palustre* L., of which at least 30,000 bundles were sold each year for kitchen usage (Duval-Jouve, 1864). Local trade in Provence was provided by vendors crying "*Leis fretadous de coussooudo*"[6] (Achard, 1785), who were not likely to be selling the hard skinned *E. hyemale*, since their merchandise would have ruined the kettles.

Abundant sources of *E. hyemale* were found in the forests along the Rhine, where specialised collectors took it to sell it to carpenters and cabinetmakers, or to plait rings of them (the so-called *Schaftheukränze,* Figure 2) to clean kitchen utensils and floors (Kirschleger, 1857). These rings, also called *Schlutte* (Acker, 1982), are identical to the one depicted by Bock (1630) and described by Bauhin: a*pud nos ancillae circulos (qualis figurae adpositus,) ad suppellectilem expoliendam conficiunt*[7] (Bauhin, 1658). Long distance commercial trade of *E. hyemale* for use by craftsmen to polish wood and metal has been reported from south-west Germany, where they were imported into Württemberg in great masses from the Rhine valley in Baden (von Martens & Kemmler, 1882). French collectors apparently drew a heavy toll on the population, since Hausser (1894) complained that "a few decades ago" at Neubreisach the traders took cartloads of *E. hyemale*, but that at the time of his writing they would have come in vain. Plants collected near Strasbourg (dept. Bas-Rhin) were sold in Nancy, 120 km to the west (Braconnot, 1828; Kirschleger, 1857) and to Paris (Duval-Jouve, 1864). Halfway between Strasbourg and Paris, in the Orient Forest near Troyes, it was available for collecting, but, to the amazement of the Troyans, traders did not know this, or preferred to pull it in other places (des Étangs, 1841). Plumier tells us, presumably from Lyon[8], that it is "a plant brought to us from the mountains". In southern France commercial trade existed where Villeneuve functioned as the hub selling horsetails collected in the Lot-valley to the market in Bordeaux (de Saint-Amans, 1821).

Yet one other possible origin should be considered, *viz.* North America. For this route I have found no historical data, unless it would account for the surprisingly large export

[6]"scouring pads of horsetails"

[7]at ours the maids make wreaths (illustrated adjacent) to polish the furniture

[8]The printer as well as the religious authorities approving the book resided in Lyon.

volume of "reeds" from the USA (Wolcott, 1795). However, the species is abundant in the USA to the extent of becoming a nuisance (Millhollon, 1987), and the larger American subspecies would explain observations of Newman and contemporaries on the size of the marketed horsetails.

Newman expressed uncertainty about the Dutch Rushes of the London markets being conspecific with English *E. hyemale*, and was supported in that opinion by other, not explicitly named, botanists. His doubts arose from the "much larger size than any British examples of *E. hyemale*" and "the much greater number of striæ, amounting in some instances to thirty-two" (Newman, 1844). Large size and high number of ridges (Figure 3) better conform to the American *E. hyemale* subsp. *affine* which has 14 – 50 ridges than the European subspecies with 14 – 26 ridges (Hauke, 1963). Johnson (Johnson & Sowerby, 1856), however, disagrees, stating that "British plant from Gamlingay Bog, Cambridgeshire, cultivated in my garden for thirty years, frequently rivals the imported "Dutch Rushes" in these respects, the number of ridges and smaller tubes varying from twenty to twenty-eight in the larger stems". In the Zalkerbos near Zwolle, the only Dutch population which historically has been associated with usage of the plants as smoothing agents, currently has stems of 1.20m tall with 25 – 26 ribs. Although such thick specimens of *E. hyemale* subsp. *hyemale* are memorable in itself, there is still a gap between Newman's 32 ridges, and the Dutch and Johnson's 26-28 ridges.

In the Netherlands, Van Hall (1854) wrote: "This plant does grow in some places of our home country, in woods and sandy lands, but it is, as far as I have been able to find out, not used, and it is by far not as heavy as the one that occurs in commerce and is brought in from elsewhere". Herman van Hall, a student of Kops, was co-author of earlier volumes of the Flora Batava (Kops & Van Hall, 1828, 1832, 1836, 1844) and therefore likely to be very well aware of the note given there, that *E. hyemale* is exported to England. His 1854 remark reads as if he has double-checked the fact, while bearing in mind that a different, larger taxon might be involved. Oudemans (1862) agreed: "The reason why, both at ours and in England, the foreign shave-grass is preferred, seems to be the latter's thicker stems".

DISCUSSION

At the onset of the eighteenth century, the name Dutch Rush for *E. hyemale* had become so established that it started to show up in print, at first with authors addressing the artificers and amateurs who would actually be using it and, almost a century later, also in the scientific botanical literature. Something must have happened with the product for people to dub it with that new name. Later authors ascribe the name to imports from Holland, but they all might have been deluded by the *Schoenoplectusus/Equisetum*-misconception, with the possible exception of John Smith (1802), who published in advance of the earliest date so far discovered that shows the entanglement. The best argument that Dutch import does explain the name is given by Aubrey's 1691 letter. While he writes that the shave-grass comes from Holland, he does not use the name Dutch Rush, and therefore this is not likely to be an *ad hoc* explanation of that name.

As for the scale of the imports during the 150 years between Aubrey and Newman, again we must sift through the mystery caused by the *Schoenoplectusus/Equisetum*-misconception. All the imports of Dutch Rush, in "great quantities" or similar wording, are likely to be ascribed to bulrushes. In the eighteenth century, the Netherlands counted over 4000 ha of land with culture of bulrushes (Maas, 2000) and this was an important export product. In 1827, 1600 loads of 63 bundles of bulrushes were declared at the

British customs, accounting for over 360 times more duty revenues than received on polishing rushes (calculations based on Parnell, 1830). If, in spite of Yeats's opinion, *E. hyemale* would have been of any observable economic significance, one would have expected it to have been seen in the exceedingly detailed port statistics, where it is not. Evidently, half a year could pass without any horsetails being legally imported. In accordance with these incidental observations, it is absent from English and Dutch trade statistics. The possibility that significant amounts of rushes have deliberately been kept from import registration is not very likely. Smugglers concentrated on low-volume contraband where the import duty exceeded the intrinsic value. It is not unreasonable to assume that anything that was taxed was also smuggled, but 20% is a low tariff compared with that levied on alcohol and tobacco, so the incentive for smugglers to bring in shave-grass must have been slight, given that at some points in British history, smuggling carried the death penalty (Richard Platt, pers. com.). The conclusion must be that even if Holland has been an important source in the horsetail trade, the trade as a whole served but a niche market.

The emerging pattern of several disjunct historic observations is that of trade routes from scattered source regions into the most accessible larger centres of population. For unknown reasons source populations closer at hand were ignored. Like Oudemans, De St.-Amans (loc. cit.) thinks it a matter of quality: "*Celle des bords du Lot est belle et plus estimée*". Sustained exploitation sometimes resulted in depletion of local stocks. In the upper Rhine Valley an infrastructure of collectors and transporters had developed who transported *E. hyemale* overland to France and downstream by river, as suggested by the toll-treaties of German rivers (Anon., 1837, 1853). The Dutch had virtually monopolised navigation on the river Rhine (MacGregor, 1843). When brought all the way down to the sea, goods would have ended up in the port of Rotterdam, ideally situated for further transport to Belgium and England. Since the species was "rather common in whole Europe, even in Russia, and especially in Sweden" (de Chalmot & Chomel, 1792), it may have been that the collectors took the product from wherever it was available in north-west Europe, including the eastern part of the Netherlands and Russia (which then included Poland). Tariffs categorising horsetails are available from many north and central European countries.

During the Napoleonic wars around 1800, reciprocal trade embargos caused interruptions in the supply of indispensable commodities. Since the French invasion of the Netherlands in 1794, bulrushes from Holland had become difficult to obtain (Anon., 1819) and consequently become expensive: "during the non-commercial intercourse between Holland and Great Britain, which lasted a number of years, a great scarcity existed in (...) Dutch Rushes, which were not to be had during the war, except in very precarious chance lots, occasionally smuggled over, at any price" (E. Smith, 1841). The same will have happened to *E. hyemale* from the continent and it may be hypothesised that in circumvention a new supply route from the United States was opened. The aberrant size of the plants reported by nineteenth century authors indicates the North American subspecies rather than the slenderer European form. If the shipping cost had allowed a profitable transport, the availability would have been virtually unlimited from the largely uncultivated American lands where the species is abundant. However, doubt exists whether the economic opportunities were recognised: "The rushes used for rubbing down are a valuable article, and grow abundantly in various parts of the United States, they are found in our own neighbourhood in the State of New Jersey; though extensively used in Europe they are scarcely known to our workmen" (Gill, 1828).

REFERENCES

ACHARD, C. F. 1785. *Dictionnaire de la Provence et du Comté-Venaissin*. 2 vols. Vol. 2, Marseille; Jean Mossy.

ACKER, A. 1982. Prêles, *Encyclopédie de l'Alsace*, 6146. Editions Publitotal, Strasbourg.

ANONYMOUS. 1350-1400. *MS. Arch. Selden. B. 35*, Bodleian, Oxford.

ANONYMOUS. 1735. Goods imported and exported to and from the port of London, from the 23rd Day of May, to the 16th Day of October inclusive, 1735. *The Political State of Great Britain* 50: 450-456.

ANONYMOUS. 1749. *Arts Companion, Or A New Assistant for the Ingenious*. London, Dublin; I. Jackson.

ANONYMOUS. 1754. *The British legacy: or, fountain of knowledge.* . London; Thomas Chandler.

ANONYMOUS. 1796. Kannenkraut. In: HÖPFNER, L. J. F. [ed.], *Deutsche Encyclopädie oder Allgemeines Real-Wörterbuch aller Künste und Wissenschaften von einer Gesellschaft Gelehrten*, 97-102. Varrentrapp und Wenner, Frankfurt am Mayn.

ANONYMOUS. 1819. Transactions of the Society, instituted at London for the Encouragement of Arts, Manufactures, and Commerce; with lhe premiums offered in the year 1817. The Literary Panorama and National Register 8 (New Series): 754-764.

ANONYMOUS. 1824. *Sr. K.k. Majestät Franz des Ersten Politische Gesetze und Verordnungen für die Oesterreichischen, Böhmischen und Galizischen Erbländer*. Vol. 50, Wien; K.K. Hof- und Staats-Druckerey.

ANONYMOUS. 1836. *Sammlung der politischen Gesetze und Verordnungen für das Laibacher Gouvernement-Gebiet im Königreiche Illyrien*. Vol. 18, Laibach (Lubljana); Eger'schen Gubernial-Buchdruckerei.

ANONYMOUS. 1837. Tarif de Douanes concerté entre la Prusse, l'Electorat de Hesse et le Grandduché de Hesse d'une part, et la Bavière et le Wurtemberg de l'autre part. En date du 31. Oct. 1833. In: DE MARTENS, G. F. & MURHARD, F. [eds.], *Nouveau recueil de traités d'Alliance, de Paix, de Trève, de Neutralité, de Commerce, de Limites, d'Echange etc, et de plusieurs autres actes servant à la connoisancce des relations étrangères des Puissances et d'Etats de l'Europe.*, 736-777. Librairie de Dieterich, Göttingen.

ANONYMOUS. 1838. *Zoll-Tariff für die Ein- und Ausfuhr der Waaren in dem österreichischen Kaiserstaate*. Wien; der kaiserliche und königliche Hof- und Staats-Arearial-Druckerey.

ANONYMOUS. 1843. Verhandeling der Stuco, of zoogenaamd Kunstmarmer. Bouwkundig magazijn of schetsen voor handwerkslieden 1: 11-12.

ANONYMOUS. 1849a. Traité entre l'Autriche, la Prusse, la Saxe, le Hannovre, le Danemarc, le Mecklenbourg-Schwerin , les duchés d'Anhalt et les villes libres anséatiques de Hambourg et de Lübeck pour regulariser les droits de douanes hanovriennes payables à Brunshaus (ci-devant à Stade) Sur l'Elbe. Conclu et signe ä Drèsde, le 13 Avril 1844. In: DE MARTENS, M. & MURCHARD, F. [eds.], *Nouveau recueil général de traités: conventions et autres transactions remarquables, servant à la Connaissance des Relations étrangères des Puissances et États dans leurs Rapports mutuels*, 473-525. Libraire de Dieterich, Göttingen.

ANONYMOUS. 1849b. Acte additionel au traité du 23 Juin 1821 sur la navigation de

l'Elbe, signé à Drèsde le 13 Avril 1844, entre l'Autriche, la Prusse, la Saxe-royale, le Hanovre, le Danemarc, le Grand-duché de Mecklenbourg-Schwerin, les Duchés d'Anhalt-Coethen, d'Anhalt-Dessau et d'Anhalt-Bernbourg et les villes libres anséatiques de Hambourg et de Lübeck. (Gesetzsamml. für die Königl. Preussischen Staaten. Jahrg. 1844. Nro 37 v. 1. Novemb.). In: DE MARTENS, G. F. & MURCHARD, F. [eds.], *Nouveau recueil général de traités: conventions et autres transactions remarquables, servant à la Connaissance des Relations étrangères des Puissances et États dans leurs Rapports mutuels*, 386-462. Libraire de Dieterich, Göttingen.

ANONYMOUS. 1853. Traité de commerce et de douanes entre l'Autriche et la Prusse, signé à Berlin, le 9 Février 1853. In: DE MARTENS, C. & DE CUSSY, F. [eds.], *Recueil manuel et pratique de traités, conventions et autres actes diplomatiques*, 134-173. F.A. Brockhaus, Leipzig.

ANONYMOUS. 1856. Binnenlandsche Berigten. *Nederlandsche staatscourant*, 28-03-1856.

ANONYMOUS. 1858. Traité de commerce et de douanes entre la Prusse et l'Autriche) signé à Berlin, le 19 février 1853. In: MARTENS, G. F. & SAMWER, C. [eds.], *Nouveau recueil général de traités: conventions et autres transactions remarquables, servant à la Connaissance des Relations étrangères des Puissances et Etats dans leurs Rapports mutuels*, 382-429. Libraire de Dieterich, Göttingen.

ARNTZEN, K. A. 1830. *Love, Anordninger, Kundgjørelser, aabne Breve, Resolutioner, m.m., der vedkomme Kongeriget Norges Lovgivning og offentlige Bestyrelse, for aaret 1829*. Christiania; Chr. Grøndahl.

ARTLOVE, M. 1730. *The art of japanning, Varnishing, Pollishing, and Gilding. Being a collection of very plain directions and receipts. Written for the Use of those who have a mind to follow those diverting and useful Amusements, and Published at the Request of several Ladies of Distinction*. London; T. Warner.

AUBREY, J. 1847. *The Natural History of Wiltshire*. Wiltshire Topographical Society.

AUBREY, J. 1848. Letter to Mr. Ray. In: LANKESTER, E. [ed.], *The Correspondence of John Ray*, 237-238. The Ray Society, London.

BAERT, J. 1943. *Jan Kops, pionier van Hollands landbouw*. 's Gravenhage; MArtinus Nijhoff.

BAILEY, N. 1756. *Universal Etymological English Dictionary*. 4th ed. Vol. 2, London; T. Waller.

BARROW, J. 1735. *Dictionarium polygraphicum: or, the Whole Body of Arts Regularly Digested*. Vol. II, London; C. Hithch & C. Davis.

BAUHIN, G. 1658. *Caspari Bauhini theatri botanici*. Vol. 1, Basel; Joannes König.

BIJLSMA, R. J. 2003. *Bosrelicten op de Veluwe. Een historisch-ecologische beschrijving*. Alterra, Wageningen, report no. 647.

BOCK, H. & SEBISCH, M. 1630. *Kräutterbuch Weylandt des Weitberhüm[m]ten vndt Hocherfharnen Herren Hieronymi Tragi genant Bock. Auff Vielfaltiges begeren vnd freundtliches ersuchen Mit vleiss übersehen, vnd mit der Kräutter zunamen, der Namen ursachen, qualitete[n], deren gradibus, gebrauch in den Apotecken, vnd sehr vielen in[n]erlichen vnd eusserlichen experimentis gemheret und gebessert. Durch Melchiorem Sebizium, der Artzeney Doctorem, vnd Professorem, auch der Statt Strassburg bestellten Physicum. Sampt Angehenckten Speisskammer ermelten herrn H. Bocken, darin[n] aber für dissmhal nichts geändert worde[n]*. 4th ed. Strassburg; Wilhelm Christian Glasern.

BOLTON, J. 1790. *Filices Britannicae*. 2 vols. Vol. 2, London.

BRACONNOT, H. 1828. Recherches chimiques sur la nature des Prêles. Annales de chimie et de physique 39: 5-24.

BRÉVAL, J. D. 1726. *Remarks on several parts of Europe: relating chiefly to the History, Antiquities and Geography, of those countires through which the author has traveled : as France, the Low Countries, Lorrain, Alsacia, Germany, Savoy, Tyrol, Switzerland, Italy and Spain*. Vol. 1, London; Bernard Lintot.

BURN, R., CHITTY, J. & CHITTY, T. 1831. *The Justice of the Peace and Parish Officer*. 6 vols. Vol. 2, London; S. Sweet & A. Maxwell.

C.K., 1701. *Art's master-piece: or, A companion for the ingenious of either sex. In two parts*. London; G. Gonyers.

CAMDEN, W. 1722. *Britannia: Or a Chorographical Description of Great Britain and Ireland (etc.) Written in Latin and Translated Into English*. 2nd ed. Vol. 1, London; Awnsham Churchhill.

CLEVERING, O. A. & VAN GULIK, W. J. M. 1990. *De aanleg van biezenbegroeiingen: mogelijkheden voor her-introduktie van biezen in het Haringvliet - Hollandsch Diepgebied*. Oostvoorne; Instituut voor Oecologisch Onderzoek.

COMELIN, J. 1683. *Catalogus plantarum indigenarum Hollandiae, cui praemissa Lamb. Bidloo dissertatio de re herbaria*. Amsterdam; Henr. & Viduam Theod. Boom.

DE CHALMOT, J. A. & CHOMEL, N. 1792. *Vervolg op M. Noël Chomel Algemeen huishoudelyk-, natuur-, zedekundig- en konst-woordenboek*. Vol. agtste deel, zijnde het XV. deel van het woordenboek, Campen; J.A. de Chalmot.

DE GORTER, D. 1781. *Flora VII provinciarum Belgii foederati indigena*. Haarlem; Bohn & Filius.

DE HAAN, W. A., VAN DE PAVERD, M., VAN RIJNSBERGEN, J., LEENDERS, P. H. J. A., WORMGOOR, J. A. & VAN GELDER, P. H. A. J. M. 2001. *Dijken als onderdeel van een systeem van bescherming tegen overstromingen*. Delft; Delft University.

DE MARTENS, G. F. & MURHARD, F. 1836. Publication officielle du Tarif de Douanes concerté entre la Hesse électorale d'une part et entre la Prusse et la Hesse grandducale de l'autre part, en exécution du Traité de douanes et de commerce, conclu le 25 Août 1831 entre les dits Etats. En date du 30 Décembre 1831. (Kurhess. Gesetz-Sammlung 1831. Dezemb. Nr.XXII.), *Supplément au Recueil de principaux traités d'Alliance, de Paix, de Trêve, de Neutralité, de Commerce, de Limites, d'Echange etc conclus par les puissance de l'Europe tant entre elles.*, 495-521. Librairie de Dieterich, Göttingen.

DE SAINT-AMANS, J. F. B. 1821. *Flore Agenaise ou Description Methodique Des Plantes observées dans le département de Lot-et-Garonne et dans quelques parties des départements voisins*. Agen; Prosper Noubel.

DE VILLENEUVE, C. 1821. *Statistique du département des Bouches-du-Rhône: avec Atlas* Vol. 1, Marseille; Antoine Ricard.

DE VRIES, H. 2008. De laatste biezentelers. *Reformatorisch Dagblad*, 10-10-2008.

DE VRIES, H., VAN DER SANDE LACOSTE, C. M. & SURINGAR, W. F. R. 1870. Flora, *Algemeene statistiek van Nederland: beschrijving van den maatschappelijken toestand van het Nederlandsche volk in het midden der negentiende eeuw*, 172-241. Vereeniging voor de Statistiek in Nederland / A.W. Sijthoff, Leiden.

DE WINTER, W. P. 2007. What's Dutch about the Dutch rush? The Pteridologist 4: 195-197.

DE WINTER, W. P. 2012. In Nomine Equiseti. Varen-Varia 25: 4-7.

DE WINTER, W. P. & LUBIENSKI, M. 2012. *Equisetum ×ascendens* Lubienski & Bennert: de eerste triploïde paardestaartbastaard in Nederland. Gorteria 36: 1-17.

DEPARTEMENT VAN FINANCIËN. 1848. *Statistiek vand den handel en de scheepvaart van het Koningrijk der Nederlanden over het jaar 1846.* 's-Gravenhage; Departement van Financiën.

DES ÉTANGS, S., ed. 1841. *Notes sur quelques plantes observées dans le département de l'Aube.*Mémoires de la Société no. 77-78. Troyes; Société académique d'agriculture, des sciences, arts et belles-lettres du département de l'Aube.

DOSSIE, R. 1758. *The handmaid to the arts*. London; J. Nourse.

DU MORTIER, B. 1869. Bouquet du littoral belge. Bulletin de la Societe de Botanique de Belgique 7: 318-371.

DUJARDIN-SAILLY, E. 1813. *Tarif chronologique des douanes de l'empire française: avec des explications.* 8th ed. Paris; Dujardin-Sailly.

DUVAL-JOUVE, J. 1864. *Histoire Naturelle des Equisetum de France*. Paris; J.B. Baillière et Fils, Libraires de 'Académie Impériale de Médicine.

ELLIS, R. 1837. *The Laws and practical Regulations forming the water-side and general Practice of the Customs*. The Laws and practical Regulations of the Customs. 4 vols. Vol. 3, London; O.H. Bailey & Co.

ESTERLY, D. 1998. *Grinling Gibbons and the Art of Carving*. New York; Harry Abrahams Inc.

FLEXNER, S. B. & HAUCK, L. C. 1993. *Random House unabridged dictionary*. 2nd ed. New York; Random House.

FLIERVOET, L. M. 1992. *Aanleg en beheer van grasland op rivierdijken*. Den Haag; Unie van Waterschappen etc.

FRANCIS, G. W. 1851. *An Analysis of the British Ferns and their Allies*. London; Simpkin, Marshall & Co.

FUCHS, L. 1543. *Den nieuwen Herbarius, dat is dat boeck van den cruyden, int welcke met groote neersticheyt beschreven is niet alleen die gantse historie, dat is, die namen, tfaetsoen, natuere, cracht ende operatie van meesten deel de cruyden, die hier ende in anderlanden wassende sijn, midtsgaders der plecken oft stede, ende den tijt waer ende wanneer sij wassen, maer oock allede wortelen, stele, bladeren, bloemen, saet, vruchten, ende insumma dat gantse wesen ende gelegenheyt van den selven, is hierinne so constelijcken ende natuerlicken na dleven gefigureert ende geconterfeyt, dat desghelijcks voormaels noyt ghesien en heeft gheweest, noch oyt inde printe ghecomen en is*. Basel; Michel Insingrin.

GERARDE, J. 1597. *The Herball or Generall Historie of Plantes*. London; John Norton.

GILL, T. 1822. *The Technical repository*. Vol. II, London; T. Cadell.

GILL, T. 1828. *Gill's technological repository*. 6 vols. Vol. 2, London; Thomas Hurst, Edward Chance & Company.

GISKES, J. H. 1979. *Jaarboeken van het genootschap Amstelodanum 71: De vioolmakersfamilies Boumeester en Menslage te Amsterdam*. Debussy Ellerman Harms bv., Amsterdam.

GLOVER, S. 1843. *The history and directory of the borough of Derby, a guide*. Derby; S. Clover & Son.

GRAFF, E. G. 1838. *Althochdeutscher Sprachschatz: oder Wörterbuch der althodeutschen Sprach*. Vol. 4, Berlin; Beim Verfasser und in Commission der Nikolaischen Buchhandlung.

HAUKE, R. A. 1963. A taxonomic review of the genus Equisetum subgenus Hippochaete. Beiheft Nova Hedwigia B: 1 - 123.

HAUSSER, E. 1894. Auf welche Weise fördern wir die Kenntnis unserer einheimischer Flora? Mitteilungen der Philomathischen Gesellschaft in Elsaß-Lothringen 2: 19-25.

HEADRICK, J. 1813. *General View of the Agriculture of the County of Angus, or Forfarshire; With Observations on the Means of Its Improvement*. Edinburgh; Board of Agriculture, Great Britain.

HELDRING, O. G. 1845. Eene vergelijking tusschen Geldersche en Noord hollandsche zeden, *Geldersche volksalmanak*, 71-101. G. van Eldik Thieme, Arnhem.

HELDRING, O. G., VAN ELDIK THIEME, G. & NIJHOFF , I. A. 1837. Gedachten van Volksvrienden, *Geldersche volksalmanak*, (s.n.). C.A. Thieme, Arnhem.

HENSLOW, J. S. 1839. *Description and Physiological Botany*. new edition ed. London; Longman &c.

HEUKELS, H. 1907. *Woordenboek der Nederlandsche volksnamen van planten: uit de gegevens verzameld door de Commissie voor Nederlandsche plantennamen*. 's-Gravenhage; Versluys.

HINDERWELL, T. 1811. *The history and antiquities of Scarborough and the vicinity*. 2nd ed. (1st ed. 1798) ed. York; Longman et al.

HOOKER, W. J. 1821. *Flora scotica, or, A description of Scottish plants*. London; Archibald Constable etc.

HOUGHTON, J. 1728. *A collection for the improvement of husbandry and trade: Consisting of many valuable materials relating to corn, cattle, coals, hops, wool, &c. With a compleat catalogue of the several sorts of earths, ... With many other useful particulars, communicated by several eminent members of the Royal Society, to the collector, John Houghton, F.R.S. Now revised, corrected, and published, with a preface and useful indexes, by Richard Bradley, ... In three volumes*. London; Woodman and Lyon.

HULTÉN, E. 1962. *The circumpolar plants. 1, Vascular cryptogams, conifers, monocotyledons.* . Handlingar / Kungl. Svenska vetenskapsakademiens (Fjaerde series). Vol. 4:8:5, Stockholm; Almqvist & Wiksell.

INTRAVAIA, L. J. & RESNICK, R. S. 1965. A Research Study of a Technique for Adjusting Clarinet Reeds. Journal of Research in Music Education 16: 45-58.

JAMES, R. J. 1745. *A Medicinal Dictionary, Including Physic, Surgery, Anatomy, Chymistry, and Botany, in All Their Branches Relative to Medicine; Together with a History of Drugs, an Account of Their Various Preparations, Combinations, and Uses; and an Introductory Preface, Tracing the Progress of Physic and Explaining the Theories Which Have Principally Prevail'd in All Ages of the World*. 3 vols. Vol. 2, London; T. Osborne.

JOHNSON, C. & SOWERBY, J. E. 1856. *The Fern Allies: a supplement to the Ferns of Great Britain*. London; J.E. Sowerby.

KALIBAN'S GROCERY AND MARKET. 1938. Advertisement of Kaliban's Grocery and Market. The mount Vernon Hawkeye-Record and the Lisbon Herald, 24 Nov. 1938.

KIRSCHLEGER, F. 1857. *Flore d'Alsace*. 3 vols. Vol. 2, Strasbourg, Paris; Victor Masson etc.

KLENNER, F. W. 1822. *Allgemeiner Zoll-Tariff für den österreichischen Kaiserstaat.* 147 vols Wien; der k.k. Hof- und Staats-Arearial-Druckerey.

KNIGHT, C. 1833. *Vegetable Substances: materials of manufacturers.* The Library of Entertaining Knowledge. London; Society for the Diffusion of Useful Knowlledge.

KONINKRIJK DER NEDERLANDEN. 1816. *Wet van den derden October 1816 over de heffing der regten van in- en uitvoer: benevens het tarief derzelve regten voor het Koningrijk der Nederlanden.* P. den Hengst & Zoon, 's-Gravenhage & Amsterdam.

KONINKRIJK DER NEDERLANDEN. 1822. *Wet van den 26. Augustus 1822, houdende het Tarief van regten op den In-, Uit- en Doorvoer van alle goederen, waren en koopmanschappen.* Staats-Secretarij, 's-Gravenhage.

KOPS, J. 1798. *Algemeen rapport der Commissie van superintendentie over het onderzoek der duinen; vol.1: Tegenwoordige staat der duinen van het voormaalig gewest Holland.* 2 vols. Vol. 1, Leyden; Herdingh en Du Mortier.

KOPS, J., ed. 1807. *Staat van den landbouw in het Koninkrijk van Holland gedurende den jare 1806.* Haarlem; Loosjes.

KOPS, J., ed. 1808. *Staat van den landbouw in het Koninkrijk van Holland gedurende den jare 1807.* Haarlem; Loosjes.

KOPS, J., ed. 1809. *Staat van den landbouw in het Koninkrijk van Holland gedurende den jare 1808.* Haarlem; Loosjes.

KOPS, J., ed. 1816. *Staat van den landbouw in de Vereenigde Nederlanden gedurende den jare 1814.* Den Haag; Algemeende 's Lands Drukkerij.

KOPS, J., ed. 1819. *Staat van den landbouw in het Koninkrijk der Nederlanden, (Noordelijke provincien) gedurende het jaar 1815.* Brussel; Stapleaux.

KOPS, J., ed. 1821. *Staat van den landbouw in het Koninkrijk der Nederlanden, (Noordelijke provincien) gedurende het jaar 1818.* Brussel; Stapleaux.

KOPS, J., ed. 1822a. *Staat van den landbouw in het Koninkrijk der Nederlanden, (Noordelijke provincien) gedurende het jaar 1821.* Brussel; Stapleaux.

KOPS, J., ed. 1822b. *Staat van den landbouw in het Koninkrijk der Nederlanden, (Noordelijke provincien) gedurende het jaar 1820.* Brussel; Stapleaux.

KOPS, J., ed. 1822c. *Staat van den landbouw in het Koninkrijk der Nederlanden, (Noordelijke provincien) gedurende het jaar 1819.* Brussel; Stapleaux.

KOPS, J., ed. 1829. *Staat van den landbouw in de Vereenigde Nederlanden gedurende het jaar 1828.* 's Gravenhage; Algemeende Lands Drukkerij.

KOPS, J. & VAN HALL, H. C. 1828. *Flora Batava of Afbeelding en Beschrijving van Nederlandsche Gewassen.* Vol. 5, Amsterdam; J.C. Sepp en Zoon.

KOPS, J. & VAN HALL, H. C. 1832. *Flora Batava of Afbeelding en Beschrijving van Nederlandsche Gewassen.* Vol. 6, Amsterdam; J.C. Sepp en Zoon.

KOPS, J. & VAN HALL, H. C. 1836. *Flora Batava of Afbeelding en Beschrijving van Nederlandsche Gewassen.* Vol. 7, Amsterdam; J.C. Sepp en Zoon.

KOPS, J. & VAN HALL, H. C. 1844. *Flora Batava of Afbeelding en Beschrijving van Nederlandsche Gewassen.* Vol. 8, Amsterdam; J.C. Sepp en Zoon.

KOPS, J. & VAN DER TRAPPEN, J. E. 1846. *Flora Batava of Afbeelding en Beschrijving van Nederlandsche Gewassen.* Vol. IX, Amsterdam; J.C. Sepp en Zoon.

KRÜNITZ, J. G. 1785. Kannen-kraut, Kandelkraut, Kandelwisch. In: KRÜNITZ, J. G., FLOERKEN, F. J., FLÖRKE, H. G., KORTH, J. W. D., HOFFMANN, C. O. & KOSSARSKI, L. [eds.], *Oekonomisch-technologische Encyklopädie, oder allgemeines System der Stats- Stadt- Haus- und Land-Wirthschaft, und der*

Kunst-Geschichte, in alphabetischer Ordnung, 146-183. Joachim Pauli, Berlin.

LANCASTER, J. 1887. *Alphita, a medico-botanical glossary from the Bodleian manuscript, Selden B. 35*. Oxford; Clarendon Press.

LAW OLMSTEDT, F., COVILLE, F. V. & KELSEY, H. P. 1924. *Standardized plant names : a catalogue of approved scientific and common names of plants in American commerce*. Salem; American Joint Committee on Horticultural Nomenclature.

LE FRANCQ VAN BERKHEIJ, J. 1780. Antwoord op de vraage, voorgesteld door de Hollandsche Maatschappye der Weetenschappen, te Haarlem: Welke Boomen, Heesters en Planten zyn 'er, behalve den Helm (Arundo Arenaria) en den Sleedoorn (Prunus Sylvestris), dewelke op de Zandduinen ter weeringe der Zandverstuivinge kunnen geplant worden ? Kan men ook eenige andere Planten aan onze Zee-stranden met voordeel gebruiken ? Zyn daar mede hier te Lande al eenige proeven gedaan ? En welke is de uitkomst daar van geweest ? *Verhandelingen uitgegeeven door de Hollandse Maatschappye der Weetenschappen te Haarlem.* XIX: 1-80.

LEE, M. R. 2001. William Withering (1741-1799): A Birmingham Lunatic. Proceedings of the Royal College of Physicians of Edinburgh 31: 77-83.

LEMAN, M. 1826. Prêle. In: CUVIER, F. [ed.], *Dictionnaire des sciences naturelles*. F.G. Levrault, Strasbourg, Paris.

LOUDON, J. C. ed. 1829. *An encyclopædia of plants: comprising the description, specific character, culture, history, application in the arts, and every other desirable particular respecting all the plants indigenous, cultivated in, or introduced to Britain, combining all the advantages of a Linnean and Jussieuean species plantarum, an historia plantarum, a grammar of botany, and a dictionary of botany and vegetable culture. The whole in English; with the synonymes of the commoner plants in the different European and other languages.* London; Longman, Rees, Orme, Brown & Green.

MAAS, G. J. 2000. *Historische geomorfologie Maas en benedenrivieren : Oude Maas, Merwede-Hollandse Biesbosch, Afgedamde Maas en Maaskant*. Alterra-rapport;075. Wageningen; Alterra, Research Instituut voor de Groene Ruimte.

MACFARQUHAR, C. & GLEIG, G. 1797. *Encyclopædia Britannica: Or, A Dictionary of Arts, Sciences, and Miscellaneous Literature*. Edinburgh; A. Bell & C. Macfarquhar.

MACGREGOR, J. 1843. *Commercial statistics: A digest of the productive resources, commercial legislation, customs tariffs, of all nations. Including all British commercial treaties with foreign states*. 1st. ed. 2 vols. Vol. 1, London; Whittaker & Co.

MACGREGOR, J. 1850. *Commercial statistics: A digest of the productive resources, commercial legislation, customs tariffs, of all nations. Including all British commercial treaties with foreign states*. 5 vols. Vol. 2, London; Whittaker & Co.

MARTIN, T. 1813. *The circle of the mechanical arts; containing practical Treatises on the various manual Arts, Trades, and Manufactures*. London; Richard Rees.

MEASOM, G. S. 1861. *Official Illustrated Guide to the Great Northern, Manchester, Sheffield, and Lincolnshire, and Midland Railways*. London; Griffin Bohn.

MEESE, D. 1768. Antwoord op de vraag, door de Hollandsche Maatschappy der Weetenschappen te Haarlem, in den jaare 1764. Voor de eerfte, en in het jaar 1766.

Voor de tweedemaal opgegeeven , om voor het begin van het jaar 1767. Te beantwoorden: welke zyn de beste en minst kostbaare middelen, om het afnemen der oevers van het Haarlemmer Meer te beletten? *Verhandelingen uitgegeeven door de Hollandse Maatschappye der Weetenschappen te Haarlem.* 10: 1-46.

MICHEL, J. E. 1802. *Statistique du département des Bouches du Rhône.* Paris; Hachette.

MILLER, P. 1745. *Groot en algemeen kruidkundig, hoveniers, en bloemisten woordenboek, behelzende de manier om moes-, bloem-, vrugt-, kruid-tuinen, wild-bossen, wijngaarden, Oranje-huizen, stook-kassen, enz. aanteleggen, enz. en allerlei gewassen te kweeken [...].* II vols. Vol. I, Leiden; Pieter vander Eyk, en de weduwe Jakob vander Kluis.

MILLER, P. 1754. *The Gardeners Dictionary: Containing the Methods of Cultivating and Improving All Sorts of Trees, Plants, and Flowers, for the Kitchen, Fruit, and Pleasure Gardens; as Also Those which are Used in Medicine. With Directions for the Culture of Vineyards, and Making of Wine in England. In which Likewise are Included the Practical Parts of Husbandry.* 3 vols. Vol. II, London; John & James Rivington.

MILLHOLLON, R. W. 1987. Control of Equisetum hyemale on drainage ditches in sugarcane. Journal of the American Society Sugar Cane Technologists 7: 57-64.

MONTIN, L. 1771. Bemerkungen über den Anbau des Flugsandes. *Der Königl. Schwedischen Akademie der Wissenschaften neue Abhandlungen aus der Naturlehre, Haushaltungskunst und Mechanik* 30: 276-283.

MOORE, T. 1861. *British Ferns and their Allies.* London; George Routledge and Sons.

MURRAY, J. A. H., ed. 1971. *Compact edition of the Oxford English dictionary, complete text reproduced, micrographically.* 2 vols. Vol. 2; Oxford; Oxford University Press.

NEWMAN, E. 1842. Art. LXXVI. - A History of the British Equiseta. The Phytologist 2: 273-278.

NEWMAN, E. 1844. *A History of British Ferns and Allied Plants.* Second (revised) edition. London; John van Voorst.

NOEL CHOMEL, M. & DE CHALMOT, J. A. 1778. *Algemeen huishoudelijk-, natuur-, zedekundig-, en konst- woordenboek.* 2nd. ed. Vol. 4, Joh. le Mair.

NOZEMAN, C. 1783. Verhandeling over heermoes, unjer of kattestaart (*Equisetum*). Antwoord op de vraeg der Maatschappy ter Bevordering vav de Landbouw: Welke zyn de Eigenschappen van de verschillende soorten van het Equisetum, by ons bekend onder den naam van Heermoes, Unjer, of Kattestaart ? Waarin bestaat de aart en hoedanigheid van deszelfs Vruchtdeelen en Voortplanting? Welk nadeel wordt doorhetzelve aan het Wei en Bouw- land toegebragt ? En welk is het door de ondervinding beproefde beste middel om hetzelve op de minst kostbaare wyze uitteroeijen ? Verhandelingen uitgegeeven door de Maatschappy ter Bevordering van de Landbouw 2: 1-66.

ØLLGAARD, B. & TIND, K. 1993. *Scandinavian Ferns.* Copenhagen; Rhodos, International Science & Art Publishers.

OUDEMANS, C. A. J. A. 1862. *De natuurlijke historie van Nederland : de flora van Nederland.* 1st ed. ed. 3 vols. Vol. 3, Haarlem; A.C. Kruseman.

PAGE, C. N. 1997. *The Ferns of Britain and Ireland.* Cambridge; Cambridge University Press.

PARNELL, H. 1830. *On Financial Reform.* London; J. Murray.

PARNELL, H. 1831. *On Financial Reform*. 3rd ed. London; John Murray.

PERNETY, D. 1771. *The history of a voyage to the Malouine, or Falkland, islands, made in 1763*. London; T. Jeffrys.

PEXENFELDER, M. 1670. *Apparatus eruditionis tam rerum quam verborum per omnes artes et scientias*. Nürnberg; Michael & Joh. Friedrich Endter.

PHILLIPS, R. 1818. *Book of english trades and library of the useful arts*. New Enlarged ed. London; J. Souter, at the Juvenile Library.

PRADA, C. 1986. *Equisetum*. In: CASTROVIEJO, S., LAÍNZ, M., LÓPEZ-GONZÁLEZ, G., MONTSERRAT, P., MUÑOZ GARMENDIA, F., PIAVA, J. & VILLAR, L. [eds], *Flora Iberica*, 21-29. Real Jardín Botánoco, C.S.I.C., Madrid.

PRATT, A. 1846. *Wild flowers of the year*. London; The Religious Tract Society.

PRATT, A. 1866. *The Flowering Plants, Grasses, Sedges, and Ferns of Great Britain. Vol. VI: British grasses, sedges and ferns*. London; Frederick Warne & Co.

RIJNLAND, H. V. 2003. *Waterkeringsbeheerplan 2003-2007 - Katern 3: Beplantingsbeleid*. Leiden, report no.

RUPPE, H. B. & HALLER, A. 1745. *Flora Jenensis Henrici Bernhardi Ruppii, ex posthumis auctoris schedis et propriis observationibus aucta et emendata*. Jena; C.H. Cuno.

RUTZ, L. M. & FARRAR, D. R. 1984. The habitat characteristics and abundance of *Equisetum* × *ferrissii* and its parent species, *Equisetum hyemale* and *Equisetum laevigatum*, in Iowa. American Fern Journal 74: 65-76.

SALVO TIERRA, E. 1990. *Guía de helechos de la Península Ibérica y Baleares*. Madrid; Pirámide,.

SCHRAVER, A. 1807. Antwoord op de vraag: Is 'er eenig middel, om het Kram- en Mat-werk aan de zeedijken, het zij met daartoe geschikte kruiden, heesters, of andere gewassen, tusschen hetzelve te planten; het zij op eenige andere wijze, duurzamer, en tegen den slag van 't zeewater meer bestand ie maken ? Nieuwe Verhandelingen Van Het Zeeuwsch Genootschap der Wetenschappen 1: 67-131.

SMITH, E. 1841. Proposed cultivation of the Dutch species of rushes in England &c. The Mechanics' Magazine, Museum, Register Journal, and Gazette 35: 34-35.

SMITH, J. E. 1793. *A Sketch of a Tour on the Continent, in the Years 1786 and 1787*. Vol. I, London; James Edward Smith.

SMITH, J. E. 1802. *English Botany; or, coloured figures of British Plants, with their essenntial characters, synonyms, and places of growth, to which will be added occasional remarks*. Vol. XIV, London; J. Sowerby.

SOCIETY FOR THE DIFFUSION OF USEFUL KNOWLEDGE. ed. 1833. *Vegetable substances: materials of manufactures*.The Library of Entertaining Knowledge London; C. Knight.

SPENGLER, G. C. 1891. *Het vastleggen en opbosschen van duinen en zandverstuivingen*. Ede; Menger.

STEEL, D. 1796. *New and complete tables of the net duties payable, and drawbacks allowed, on goods, wares, and merchandises, imported into, exported from, and carried coastwise in, Great-Britain, agreeable to the act of the 27th Geo. III. called the Consolidation-Act, and corrected to the year 1796*. London; D. Steel.

STEWART, J. A. 1815. *The young woman's companion; or, Female instructor*. Oxford; Bartlett & Newman.

SYKORA, K. V. & LIEBRAND, C. I. J. M. 1987. *Natuurtechnische en civieltechnische*

aspecten van rivierdijkvegetaties. Wageningen; Landbouwuniversiteit.

TAILLARD, P.-A. & DALMONT, J.-P. 2012. *Scraping technique for clarinet reeds derived from a static bending simulation*. Proceedings of the Acoustics 2012 Nantes Conference, Nantes, France: 2735-2740.

TARGIONI TOZZETTI, O. 1813. *Istituzioni botaniche del dottore Ottaviano Targioni Tozzetti*. 3rd ed. Vol. III, Firenze; Guglielmo Piatti.

TECHNISCHE ADVIESCOMMISSIE VOOR DE WATERKERINGEN. 1985. *Leidraad voor het ontwerpen van rivierdijken*. 2 vols. Vol. 1, Den Haag; Staatsuitgeverij.

TRIMMER, J. 1842. *Practical chemistry for farmers and landowners*. London; John W. Parker.

TURNER, W. 1538. *Libellus de herbaria novus, in quo herbarum aliquot nomina greca, latina, & Anglica habes, una cum nominibus officinarum, in gratiam studiose inventutis nunc primum in lucem aeditus*. William Turner : Libellus de re herbaria, 1538. The names of herbes, 1548. London; Ray Society, facsimile 1965.

VAN DER AA, A. J., ed. 1851. *Aardrijkskundig woordenboek der Nederlanden*.13 vols. Vol. 13 (Z & app.). Gorinchem; J. Noorduyn.

VAN EYS, J. N., REINHART VAN MARLE, C. G., TEMMINCK, M., VAN DER GOES, F. & VAN STYRUM, J. 1799. *Ontwerp tot vruchtbaarmaking der duinen: zijnde het tweede deel van het Algemeen Rapport der Commissie van Superintendentie over het Onderzoek der Duinen*. 2 vols. Vol. 2, Leyden; Herdingh en Du Mortier.

VAN GEUNS, S. J. 1789. Antwoord op de vraag, voorgesteld door de Hollandsche Maatschappye der Weetenschappen, te Haarlem: Welken zyn de onderwerpen betreffende de Natuurlyke Historie onzes Vaderlands, waarvan men met gegronde reden te verwachten hebbe, dat eene verdere naspooring ten nutte van het Vaderland verstrekken zal? *Verhandelingen uitgegeeven door de Hollandse Maatschappye der Weetenschappen te Haarlem*. XXVI: 231-316.

VAN HALL, H. C. 1843. De Heermoes of kwade aard en de middelen tot hare verdelging voorgeslagen. *Tijdschrift ter bevordering van Nijverheid* 8: 1.

VAN HALL, H. C. 1854. *Neerlands plantenschat, of landhuishoudkundige flora, behelzende eene beschrijving der onkruiden, vergiftige en nuttige inlandsche planten en der in onzen landbouw gekweekte gewassen*. Leeuwarden; G.T.N. Suringar.

VAN HALL, H. C., MIQUEL, F. A. W. & DASSEN, M. 1832. *Flora belgii septentrionalis, sive index plantarum indigenarum, quae hucusque in 7 provinciis foederatis repertae sunt = Flora van Noord-Nederland, of korte aanwijzing der in het wild wassende planten, welke tot nu toe in de voormalige 7 vereenigde gewesten gevonden zijn. Pars 1: Equisetaceae, Filices, Marsiliaceae, Lycopodiaceae, Musci et Hepaticae = Bedektbloeijende planten, (paardestaartigen, varens, wortelzadigen*. 2 vols. Vol. 2, Amsterdam; J.C. Sepp.

VAN MEERTEN-SCHILPEROORT, A. B. 1830. Een theekistje à la milionade of à la chinoise. Penélopé, of Maandwerk aan het vrouwelijk geslacht toegewijd 6: 85-87.

VON MARTENS, G. M. & KEMMLER, C. A. 1882. *Flora von Württemberg und Hohenzollern*. 3rd ed. 2 vols. Vol. 2, Heilbronn; Gebr. Henniger.

VUYCK, L. 1898. *De plantengroei der duinen: overzicht van het voorkomen der planten in het duingebied en de veranderingen die in de flora zijn opgetreden in de laatste vijftig jaar in het bijzonder met het oog op den aanleg van*

duinwaterleidingen. PhD, Leiden University, Leiden.

WARDLAW, A. C. & LEONARD, A., eds. 2005. *New Atlas of Ferns & Allied Plants of Britain & Ireland.* BPS Special Publication no. 8. London; The British Pteridological Society.

WEBSTER, N. 1913. *Webster's Revised Unabridged Dictionary of the English Language.* G. & C. Merriam Co.

WEEDA, E. J., WESTRA, R., WESTRA, C. & WESTRA, T. 1985. *Nederlandse Ecologische Flora.* 5 vols. Vol. 1, Amsterdam; IVN.

WEEDA, E. J., WESTRA, R., WESTRA, C. & WESTRA, T. 1994. *Nederlandse Ecologische Flora.* 5 vols. Vol. 5, Amsterdam; IVN.

WHITWORTH, C. 1777a. *A register of the trade of the port of London; specifying the articles imported and exported, arranged under the respective countries; with a list of the ships entered inwards and cleared outwards. Number I. January, February, and March, 1776.* London; G. Kearsly, W. Flexney, G. Robinson, J. Robson, J. Walter, T. Cadell, J. Sewell.

WHITWORTH, C. 1777b. *A register of the trade of the port of London; specifying the articles imported and exported, arranged under the respective countries; with a list of the ships entered inwards and cleared outwards. Number II. April, May, and June, 1776.* London; G. Kearsly, W. Flexney, G. Robinson, J. Robson, J. Walter, T. Cadell, J. Sewell.

WILKINSON, C. C. 1858. *Weeds and wild flowers: their uses, legends, and literature.* London; John van Voorst.

WITHERING, W. 1776. *A botanical arrangement of all the vegetables naturally growing in Great Britain.* 1st ed. 2 vols. Vol. 2, London; T. Cadell etc.

WITHERING, W. 1792. *A botanical arrangement of British Plants.* 2nd ed. 3 vols. Vol. 3, Birmingham; G.G.J. & J. Robinson, etc.

WOLCOTT, O. 1795. *Abstract of the Goods, Wares, and Merchandize, exported from the United States, from the 1st October 1793, to the 30th September 1794.* Philadelphia; Francis Childs.

YEATS, J. 1870. *The natural history of commerce.* London; Cassell, Petter & Galpin.

SHORT NOTE

PLAGIOGYRIA MINUTA IS DISTINCT FROM *P. EGENOLFIOIDES* VAR. *EGENOLFIOIDES*

Two fern collections from Gunung Gaharu, Serian District, 1st Division, Sarawak, on the border with Kalimantan in Borneo, have usually been filed with grammitid ferns in herbaria. They are *Anderson SAR 15696* and *Ilias & Azahari SAR 35673*, both seen in K and SAR, and said to be in L also. Both collections grew on sandstone cliffs, at 610 m and 790 m respectively, and are conspecific. They differ from grammitids in numerous morphological characters, however, and actually belong to *Plagiogyria*.

The Flora Malesiana treatment of *Plagiogyria* (Zhang & Nooteboom, 1998) provides the most up-to-date account of the genus in Borneo, but the specimens were difficult to key to species because although they had the crenate sterile pinna margins of *P. egenolfioides* (Baker) Copel., the sterile pinnae were slightly narrowed at base, not auriculate which is a character of this species. The key to varieties of *P. egenolfioides* indicates that the collections belong to var. *egenolfioides*, being dwarf and with obscure aerophores only at the stipe base, but the description of this variety also states that most of the sterile pinnae are auriculate. *Plagiogyria minuta* Copel. is listed in the synonymy of *P. egenolfioides* var. *egenolfioides* and examination of the image of the type, MICH 1190812, shows that not only is it the same taxon as the Gunung Gaharu plants, but also that it would not key to *P. egenolfioides* var *egenolfioides* either, because of the shape of the pinna bases. Copeland (1915) noted that *P. minuta* was "an evident and near relative of *P. egenolfioides,* but much smaller throughout, and the sterile pinnae usually narrowed at the base instead of cordate or auricled". The Flora Malesiana account needs to be revised to take into account the differences between the two taxa.

REFERENCES

COPELAND, E. B. 1915. Notes on Bornean Ferns. Philippines Journal of Science C Botany 10(2): 145-149.

ZHANG, X. C. & NOOTEBOOM, H. P. 1998. Plagiogyriaceae, in Flora Malesiana Series II, Volume 3: 295-316, Flora Malesiana Foundation.

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SHORT NOTE

ACROSORUS NUDICARPUS TRANSFERRED TO *XIPHOPTERELLA*

Acrosorus nudicarpus P.M.Zamora & Co. is a grammitid fern (Polypodiaceae) known only from ultramafic substrates on Palawan Island in the Philippines (Zamora & Co, 1981) and Mount Kinabalu in Sabah, Malaysia (Borneo) (Parris et. al., 1992 as *Xiphopteris nudicarpa* (P.M.Zamora & Co) Parris). Although it was described in *Acrosorus*, it differs from all other member of the genus in having hydathodes at the vein endings on the adaxial surface of the lamina, a character shared with several species of *Xiphopterella*. The following new combination is proposed:

Xiphopterella nudicarpa *(P.M.Zamora & Co) Parris,* **comb. nov.**, based on *Acrosorus nudicarpus* P.M.Zamora & Co, Nat. Appl. Sci. Bull. Univ. Philipp. 32: 47 (1981). Type: Philippines, Palawan, Mt Mantalingahan, Iloilo Ridge, c. 1700 m, March-April 1977, *Co* 1776 (holotype PNH 199345!; isotypes A, K, L, LWG, MICH barcode 1115915!, PUH).

REFERENCES

PARRIS, B. S., BEAMAN, R. S. & BEAMAN, J. H. 1992. The Plants of Mount Kinabalu. 1. Ferns and Fern Allies. Royal Botanic Gardens, Kew. 165 pp.

ZAMORA, P. M. & CO, L. L. 1981. New species of ferns (Filicopsida) from Palawan, Philippines. Nat. Appl. Sci. Bull. Univ. Philipp. 32: 43-51.

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MORTON, C.V. 1947. The American species of *Hymenophyllum*, section *Sphaeroconium*. Contr. U.S. Natl. Herb. 29(3): 139-201.

STEVENSON, D.W. & LOCONTE, H. 1996. Ordinal and familial relationships of pteridophyte genera. In: CAMUS, J.M., GIBBY, M. & JOHNS, R.J. (Eds) Pteridology in perspective, pp. 435-467. Royal Botanic Gardens, Kew.

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